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Welsh Weather-Proverbs.

By P. RHYS-GRIFFITHS, M.B., B.S. (Lond.).

Read before the Society, March 8th, 1894.

MY object in bringing before the Naturalists' Society the subject of Welsh Weather-Lore is to draw attention to the wealth of material bearing upon this and kindred subjects lying within the field of operations of this Society.

The collection and systematic arrangement of Folk-Lore hardly comes within the sphere of a scientific society. We are, however, somewhat cosmopolitan in our aims, and if I can succeed in stimulating some of those members who have the leisure to take an interest in this subject and pick up scraps of folk-lore, in addition to geological and other specimens in their wanderings about the country, it will not be in vain that I have brought the subject to the notice of this Society.

Unfortunately to English readers, the Welsh Folk-Lore, which has hitherto been published, is not readily accessible because clothed in an unfamiliar language; and I must confess that the chief difficulty which I have had to contend with in the preparation of these few notes has been to make an intelligible English rendering of the Welsh proverbs. The path from idiomatic Welsh to a free English translation is a difficult one, and although I have called to my aid one or two very capable friends, I must ask your indulgence for many obviously crude translations and for some doggerel verse.

When I first contemplated bringing this subject before the Society, I thought it might be interesting to compare the weather-lore of other countries with our own. The French, German, Italian, Spanish, and

Portugese proverbs are numerous, very interesting, and often very quaint; but I found it would be impossible to deal with them within the limits of this short paper. Indeed, the subject of Welsh Weather-Lore is in itself too extensive for one paper, and I propose to speak only of the Welsh and English proverbs in so far as they are connected with the *months* and *seasons* of the year.

JANUARY.—The month of January is generally a month of cold and severe weather. For agricultural operations, mild weather and rainy weather in this month are regarded as very unfavourable. These are the sentiments that find embodiment in our proverbs.

1 "If there is sun in January no good we'll see,
For in February and March sure revenge will be."

3 "Better to see thy mother on her bier
Than to see fair weather in Janiveer."

Compare with these the English proverbs :—

"March in Janiveer
Janiveer in March, I fear."

"If January kalends be summerly gay
'Twill be winterly weather to the kalends of May."

"A warm January, a cold May."

"The Welshman would rather see his dam on her bier,
Than see a fair Februeer."

The severity of the weather is forcibly pointed out by the next proverb, which is one of the agricultural proverbs, which I have extracted from the Iolo Manuscripts :—

"January will strike down."

We have many English proverbs bearing out the same idea :—

"Jack Frost in Janiveer
Nips the nose of the nascent year."

"The blackest month in all the year
Is the month of Janiveer."

It is possible that some of you may be tempted to test the accuracy of these weather-prognostics. Let me ask you to bear in mind that these old proverbs came into existence, most of them, long before what is commonly known as the change of style. Christmas Day, for example, under the old style, corresponds with January 6th of our present or new style. Whenever dates are given the necessary allowance must be made for these important changes.

FEBRUARY.—The month of February was, apparently, regarded by our forefathers as stormy and boisterous, accompanied by much rain. The month gone by displayed in all respects the essentials of a typical February :—

1 "February blows, and the little bird freezes in its nest."

2 "February blows, and gives no rest,
It blows the little bird off its nest."

3 "February blows the snake from its nest.'

4 "February will despoil a giant."

5 "If the grass grows in Februeer,
It grows the worse for it all the year."

6 "Februeer fill ditch.
March drink ditch."

The same idea pervades certain English proverbs. A fair February was thought to foreshadow a bad summer, and, indeed, to interfere with the well-being of the rest of the year:—

"All the months in the year,
Curse a fair Februeer."

"If February give much snow,
A fine summer it doth foreshow."

"February doth cut and shear."

"February fill dike be it black, or be it white."

MARCH.—The next month, March, was in the old days, as it is unquestionably now, regarded with feelings of fear and no small amount of terror. It is a month of many weathers. For argicultural purposes being the seed-time of the year, the two favouring conditions are dryness and cold:—

1 "March will slay,
April will flay."

2 "A peck of March dust is worth its weight in gold."

3 "A small bagful of March dust, is worth a large bag of the king's gold."

4 March wind and May sunshine will make ugly what would not otherwise be so.

5 If the meadows grow in March, plenty will follow.

6 As much as the birds sing before St. David's Day,
They will regret it before Lady Day (March 25th).

Compare with these:—

"A bushel of March dust is worth a king's ransom."

"A wet March makes a sad harvest."

"A dry and cold March never begs its bread."

"March grass never did good."

The last proverb is very aptly expressive of instability:—

7 "Like March snow on a stone."

And here an English proverb comes to our assistance in explanation:—

"When Candlemas Day is come and gone,
The snow lies on a hot stone."

APRIL.—

1 Happy our lot, if a mild April will clothe the ground and the branches of the grove.

2 Wet and warmth in April will cause the farmer to sing like a nightingale.

3 A dry April everything languishes.

4 A kind April will wet the bush and dry the bush.

5 A rough April—the little pig dies.

6 April will slay.

The proverbs of the month of April are remarkable on account of the divergence of opinion which, apparently, existed between our Welsh and English forefathers in regard to the climatic conditions most favourable for agricultural operations. Compare with the foregoing the following English proverbs :—

"A cold April, the barn will fill."

"Cold April gives bread and wine."

"April showers bring forth May flowers."

MAY.—If we may judge from the proverbs before us, our forefathers welcomed a cold month of May :—

1 Flowers before May, as well away—

2 Flowers before May, better away.

3 Rain (constant) in May better away.

4 Cold May, full barn.

5 Cold May, warm barn.

6 May will cheer the heart.

7 A showery May, a loaded land of corn and hay.

8 A cold May will make a full barn and an empty churchyard.

9 "A cold May gives healthy days,
And a summer free from sickness."

10 Cold wind in May will not lessen the crops.

Amongst the English proverbs we have :—

"A hot May makes a fat churchyard."

"A leaky May and a warm June,
Bring in the harvest very soon."

JUNE.—The most favourable climatic conditions for this month were sunshine, warmth, and rain :—

1 "A sunny June will make an early-rising company of reapers."

2 "A rainy June will make the grass and cornblades spring."

3 "Sleep not in June for (forget not) the fost of January,
Be not careless when your barn is not full."

4 "June will make a merry doorway."

5 "In the month of June merry's the eye ;
If it be partly wet and partly dry."

In English we have :—

"A good leak in June,
Sets all in tune."

"Calm weather in June,
Sets corn in tune."

JULY.-- For the month of July I have only two proverbs. Perhaps the most widely known English Weather-Proverb is associated with this month, that in reference to St Swithin's Day. A wet July is not favourable to agricultural work. When the corn begins to fill a little rain does no harm :—

1 "July a merry cattle fold."

2 "It is poison to the horse and the ox, if July be not dry."

In English we have :—

"No tempest good July, lest corn come oft blue by."

"A shower in July, when the corn begins to fill,
Is worth a plough of oxen and all belongs there till."

The succeeding months of the year are by no means rich in Welsh proverbs, and there is also a similar scarcity of English ones :—

1 "August, a merry host."

2 "If August be dry, the Welshmen may rejoice."

In English we have :—

"Dry August and warm
Doth harvest no harm."

"If the 24th of August (St. Bart's Day) be fair and clear
Then hope for a prosperous Autumn that year."

SEPTEMBER.—

1 "September rejoices the birds."

2 "If mid-September be dry, it
Will make a cellar full of ale."

In Scotland :—

"If dry be the buck's horn
On Holy rood morn (Sept. 26th)
'Tis worth a kirk of gold ;
But if wet it be seen
Ere Holy rood e'en
Bad harvest is foretold."

In connection with October and November I have no proverbs except two taken from the Iolo Agricultural Proverbs. It is possible that the temporary cessation of agricultural operations during the short period succeeding the corn-harvest may account for this dearth of proverbs. After the long days and the very arduous duties of harvest time well may our country friends exclaim—

"Come, October, for cheerful is social intercourse."

SPRING.—Associated with the seasons of the year there are many very interesting proverbs :—

1 "A wet spring, a late harvest."

2 "One swallow does not make a spring,"

3 "Spring mist, sign of long rushes.'

4 "Spring mist, a litter of fresh rushes."

5 "A gossamery spring and a full pocket."

SUMMER.—

1 "A Summer till New Year's Day,
Winter till first of May."

2 "Better half a seed than half a summer."

3 "Summer till New Year's Day,
Winter till 24th of June."

4 "A dry summer never left a famine after it."

WINTER.—

1 "An early winter—a long winter."

2 "A green winter—a rich graveyard."

3 "A green winter—a grey spring."

4 "Winter mist a sign of snow."

The list which I have prepared is by no means exhaustive of the proverbs upon the subjects treated. It will suffice, however, to shew that an interesting field for inquiry lies within our reach. I have many more proverbs bearing directly upon the weather-prognostics of Fine Weather and Rain; others relating to Clouds, Wind, Fogs, and Mists. Especially interesting are the old sayings based on observations of the habits of common domestic animals.

All over the country there are scattered hundreds of proverbs. May I earnestly invite the co-operation of the members of this Society in the important work of collecting them. The history of a country is incomplete without its system of mythology. We can all be collectors of facts. It will remain for some Darwin to connect them into a systematic whole.

I am anxious that the scattered factors of our folk-lore should be collected, so that the Welsh Owen or Darwin, when he comes, may find at hand the materials for a complete and connected system of mythology.

HIN-DDIAREBION CYMREIG (WELSH WEATHER-PROVERBS).

IONAWR (JANUARY).

1 Haul yn Ionawr ni mad welawr,
Mawrth a Chwefrawr a'i dialawr.

2 Gwell gweled dodi'th fam ar elor,
Na gweled hinon teg yn Ionor.

3 Ionawr a dery i lawr.

CHWEFROR (FEBRUARY).

1 Chwefror chwith; sytha'r deryn ar ei nyth.

2 Chwefror chwyth y 'deryn bach oddiar ei nyth.

3 Chwefror chwyth y neidr o'i nyth.

4 Chwefrawr yspail cawr.

5 Os ym mis Chwefror y tyf y pawr
Trwy'r flwyddyn wed'yn ni thyf ef fawr.

6 Chwefror a leinw y cloddiau,
A Mawrth a'i hyf yn foleidiau.

MAWRTH (MARCH).

1 Mawrth a ladd, Ebrill a fling.

2 Pecaid o lwch Mawrth sydd werth ei bwysau'n aur.

3 Cyded bach o lwch Mawrth a dâl
Cydaid mawr a aur y brenin.

4 Gwynt mis Mawrth a haul mis Mai
A wna hagr lle ni bai.

5 Os ym Mawrth y tyf y ddol
Gwelir llewndid ar ei ol.

6 Gymmaint a gano'r adar cyn Gwyl Ddewi
Hwy a'i llefant cyn Gwyl Fair.

7 Mal eiry Mawrth ar ben maen.

EBRILL (APRIL).

1 Gwyn ein byd os Ebrill mwyn
A wisg y llawr a gwrysg y llwyn.

2 Gwlybyn a gwres yn Ebrill a wna i'r ffermwr ganu fel yr eos.

3 Ebrill sych pob peth y nych.

4 Ebrill fwyn, gwlych lwyn, sych lwyn.

5 Ebrill garw, porchell mawr.

6 Ebrill a fling.

MAI (MAY).

1 Blodau cyn Mai malpai na bai.

2 Blodau cyn Mai, goreu na bai.

3 Gwlaw mis Mai goreu na bai.

4 Mis Mai oer a wna ydlan lawn.

5 Mai oer 'sgubor lawn.

6 Mai oer a wna ysgubor gynhes.

7 Mai a gwyn y galon.

8 Mai gwlybyrog gantho cair
Llwyth ar dir o ŷd a gwair.

9 Mis Mai oer a wnai'n ddi-nag
'Sgubor lawn a mynwent wag.

10 Mai oer a fydd yn iach ei ddydd
Yn argoel haf heb fawr yn glaf.

11 Awel oer mis Mai
Ni wna'r cynydau ddim yn llai.

MEHEFIN (JUNE).

1 Mehefin heulog a wna medel moch ddwyreog.

2 Gwlaw mis Mehefyn, cynydd gwair ac egyn.

3 Na chwsg, Fehefin, rhag rhew mis Ionawr,
Na fydd ddiofal heb lawn ysgubor.

4 Mehefin llawen gorsing.

5 Mis Mehefin gwych os daw
Peth yn sych a pheth yn law.

GORPHENAF (JULY).

1 Gorphenaf llawen buarth.

2 Gwenwyn blin i'r march a'r ych
Mis Gorphenaf na fo sych.

AWST (AUGUST).

1 Awst—llawen gŵr y tŷ.

2 Awst os ceir yn anian sych
A wna i Gymro ganu'n wych.

MEDI (SEPTEMBER).

1 Medi llawen adar.

2 Hanner Medi'n sych a wna
Llyngell lawn o gwrw da.

HYDREF (OCTOBER).

1 Hydref llon cyfarwar.

TACHWEDD (NOVEMBER).

1 Tachwedd dechreu'r galar.

RHAGFYR (DECEMBER).

1 Rhagfyr gocheler ei fân.

GWANWYN (SPRING).

1 Gwanwyn gwlyb, cynhauaf diweddar.

2 Un wenol ni wna wanwyn.

3 Niwl y gwanwyn arwydd hirfrwyn.

4 Niwl y gwanwyn gwasarn irfrwyn.

5 Gwanwyn a gwawn, llogell yn llawn.

HAF (SUMMER).

1 Haf hyd Galan, gauaf hyd Fai.

2 Gwell hanner had na hanner haf.

3 Haf hyd Galan, gauaf hyd Wyl Ifan (Mehefin 24ain).

4 Ni edewis haf sych newyn erioed ar ei ol.

GAUAF (WINTER).

1 Gauaf cynar, hir y trig.

2 Gauaf glas wna fynwent fras.

3 Gauaf glas wna wanwyn gwyrdd.

4 Niwl y gauaf, arwydd eira.

5 Gauaf crin, cawn trwm.

6 Gauaf gyd llyny llym elywid llongau.

7 Gauaf gwlyb, mynwent lawn.

Contribution towards an Account of the Narcissi of South Wales.

By CHARLES TANFIELD VACHELL, M.D., Lond. &c.

Read before the Society, April 5th, 1894.

SOME two years since having learned, with much pain, the story of the disappearance of the Tenby daffodil as one of our local wild plants, it occurred to me that perhaps a note on this subject might be fittingly recorded in our Transactions. I was thus led to make fuller enquiries, and it having been pointed out to me that so far no attempt had been made to enumerate the Welsh Narcissi, I was induced to allow my notes to take the form of a first instalment towards a more complete list of this genus of plants. I am well aware that my list is probably very incomplete, but I offer this paper less for what it is worth than as an inducement to others with more opportunities than fall to my lot to pursue the subject to the end.

Were I to proceed on strictly botanical lines, and to exclude mention of all but native Narcissi, then indeed my task would be a simple one, for it is generally considered by botanists that in Britain we have but one really native Narcissus, viz., the Daffodil or Lent Lilly—Narcissus pseudo-narcissus. Such a plan would have entirely defeated my object, which is to notice all those species and varieties which, having long flourished in a wild state, may be said to have become naturalized in the Principality. I have received valuable assistance from many friends, foremost amongst whom I would mention Mr. Thomas H. Thomas and Mr. Robert Drane. Mr. Wm. Davis has

greatly assisted by preparing a number of beautiful photographs, some of which illustrate the paper; and Mr. Neale has carried out an experiment in preserving the flowers in ice. I would here wish also to tender my thanks to Mr. F. W. Burbidge, Trinity College Botanical Gardens, Dublin, to whom I am deeply indebted; also to the Rev. Wolley Dod; Mr. Peter Barr, of London; and Professor Vines, of Oxford.

Before commencing, let me tell the story to which I previously referred.

For a great many years the Tenby daffodil had thriven in Pembrokeshire, until the early days of the present revived taste for Narcissi as flowers for cultivation, but it has now been driven into holes and corners, and is only to be found existing, under protection, in parks and shrubberies. Mr. J. E. Arnett, a well-known resident of Tenby, writing to me on 17th January, 1893, says: "From enquiries, I gather that up to 1885 a steady trade had been done by people here in the bulbs, men being sent into the country districts by one man here systematically to hunt for them. About half a million bulbs were sent to London in the course of two years. On some fields belonging to Holloway Farm, which you no doubt remember is just outside Tenby on the Marsh road, the daffodil grew very abundantly; the owner, a Mr. Rees, learning the value of the flowers at Covent Garden, sold the bulbs, the entire crop on the fields, for £80. One of the Collins's (Collins Bros., of Covent Garden,) came down specially to receive them. Hearing that Rees was at Pembroke Dock, he, in company with others, met the train at Penally by which Rees was returning, and on the spot offered him ten £5 notes; the offer was refused, and the sum I have named was subsequently obtained, I believe from another firm of dealers. Since that disgraceful extirpation took place, the country round has been well searched by the dealers and their agents till few of the beautiful variety remain. At Lydstep, the double ones occur plentifully on one farm, but the single one is, I believe, now only met with here and there in small patches. It is generally stated that Narcissus obvallaris is usually found near the site of habitations. At Knightson, however, where both single and double occur, there is now no house within a mile; but some forty years since, the former owner of this estate, a Miss Richards, was in the habit of having summer retreats built and grounds laid out and planted, so possibly even there they may be the result of previous cultivation."

The headquarters of the Narcissi would seem to be the Pyrenees, but the whole of western Europe, from the Atlantic to the longitude of the Adriatic, may be regarded as the home of the daffodil (Dod.). Most of those varieties which are now cultivated in Britain have been introduced and grown in our gardens since A.D. 1500, but it is probable that the commoner species were introduced long before.

Altogether some twenty species are known to exist in a wild state, and it is a curious fact with regard to the Narcissi *that all these species hybridise freely, and even the hybrids themselves are capable of being*

Narcissus pseudo-narcissus, var : obvallaris (The Tenby daffodil).

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crossed. This is almost peculiar to the Narcissi. In Britain the list of native Narcissus is reduced to very modest limits; thus in the last (8th) edition of the London Catalogue of British Plants,—May, 1886,—the only Narcissi given as native are (1) Narcissus pseudo-narcissus. Linn. 76; (2) Narcissus pseudo-narcissus lobularis Haw. Narcissus major, Narcissus incomparabilis, Narcissus biflorus, and Narcissus poeticus are mentioned in italics, which indicates that they are considered as introductions. Again the third and last edition (1884) of Sir J. D. Hooker's "Student's Flora of the British Isles," enumerates as follows:—(1) Narcissus pseudo-narcissus proper, leaves slightly glaucous, perianth segments oblong-lanceolate sulphur-yellow, crown lemon-yellow, obscurely six-lobed. (2) Var.: Narcissus lobularis. Haw. (*Narcissus Bromfieldii* Syme); perianth and corona both lemon-yellow, corona distinctly six-lobed The Tenby daffodil (Narcissus cambricus* Haw.) scarcely differs. (3) Var.: *Narcissus major* L. more robust, perianth-segments broader, and corona lemon-yellow, crown with six rounded lobes. The great Spanish daffodil. (4)† Narcissus biflorus, *Curt;* leaves keeled, flowers 1—3 salver shaped, crown short concave membranous. Naturalized in sandy fields; fl. April—May. Bulb 1—1½in., outer scales membranous. *Leaves* very long, acutely 2-edged. Perianth 1½in. diam., white or pale straw-coloured, pedicel slender; tube 1in., slender; segments broadly ovate, obtuse; crown pale yellow. Distrib. W. Europe.

Mr. F. W. Burbidge, of Trinity College Botanical Gardens, Dublin, one of the best authorities on the Narcissi, writing on the 3rd May, 1892, says: "Of the three species of Narcissi figured in the English botany, viz., Narcissus pseudo-narcissus, Narcissus biflorous, and Narcissus poeticus, I believe only the first is a true native of Great Britain, the other two are naturalized only. There are no native species in Ireland, although many species are naturalized. Thus the list of daffodils, native and naturalized in Britain, includes the following:—(1) Narcissis pseudo-narcissus; (2) Narcissus pseudo-narcissus variety lobularis (or obvallaris); (3) Narcissus pseudo-narcissus major; (4) Narcissus incomparabilis; (5) Narcissis biflorus; (6) Narcissus poeticus; (7) Narcissus telamonius plenus.

No. 1 is common throughout England and Wales, but is only naturalized in Scotland and Ireland.

No. 2, Narcissus obvallaris, is found only in Pembrokeshire, and naturalized near Gorey, County Wexford, Ireland.

No. 3, Narcissus pseudo-narcissus major L., is included in Sir J. D. Hooker's list in his "Student's Flora." This I have entirely failed to identify, or find any habitat for.

No. 4, Narcissus incomparabilis. This is the Star Narcissus, but I find no habitat recorded for it.

* The true Tenby daffodil is totally different to *Narcissus cambricus*, which is not wild in Britain. Perhaps from the old province of Cambray?

† Narcissus biflorus is now proved to be a hybrid between N. tazetta and N. poeticus.

No. 5, Narcissus biflorus, has a white perianth with pale yellow crown. It is especially abundant in Devonshire, and is naturalized in sandy fields.

No. 6, Narcissus poeticus, the Poet's Narcissus, is said by Phillips, 1824, in his "Flora Historica," to be wild in Norfolk and Kent. It seldom produces seed in England, and it is, therefore, probable that the few plants that have been found are the offsets from imported plants, probably of as early a date as the time of the Romans, who we may naturally conclude would not fail to plant the flowers of their favourite poet, when we discover that they paved the floors of their dwellings with tessellae that represented his tales.

No. 7, Narcissus pseudo-narcissus flore pleno, is the double English daffodil. Narcissus telamonius flore pleno (= Van Sion), is the large Dutch double daffodil.

We have next to consider what varieties and species have been, or are to be, found in our own neighbourhood. With the exception of the Cardiff district, of which "The Flora of Cardiff," by John Storrie, gives a very full account, the publications referring to the Botany of South Wales are few, and far from complete. Mr. Storrie gives under Narcissus as follows—viz.:

1. Narcissus poeticus, very rare, Llanishen reservoir, probably planted.
2. Narcissus biflorus (pale narcissus), rare, bank of river Ely, apparently quite wild.
3. Narcissus-pseudo-narcissus (daffodil), frequent, Llanishen, Coedriglan.
4. Narcissus incomparabilis, damp meadows near Pencoed and Coed-y-Mwstwr.

To these I would add:—

5. Narcissus obvallaris, Pembrokeshire.
6. Narcissus incomparabilis, var. "Sir Watkin."
7. Narcissus telamonius flore pleno.
8. Narcissus obvallaris-plenus, Penylan.

No. 1. Narcissus poeticus; the Llanishen plant, was probably a recent escape from a garden. In 1888, Mr. Thomas Henry Thomas found this plant growing plentifully in patches about the fields at St. Edrin's, Trehale Farm, and other farms in Pembrokeshire. Mr. Storrie reports it as still growing plentifully at St. Hilary (How Mill).

No. 2. Narcissus biflorus. In addition to Mr. Storrie's habitat on the Ely river, I find in an old copy of "Withering's Botany," which belonged to the Rev. James Evans, formerly Rector of Llandough, Cardiff, and a competent observer, a note to the effect that this plant grew in 1848 (May 7th) in a meadow opposite Cwrt-y-vil, Penarth. It also is recorded from Tenby.

No. 3. Narcissus pseudo-narcissus occurs very abundantly in many places, Pwllypant, Coedriglan, Llanishen, Miskin, Pencoed,

Ruperra, etc. It varies slightly in some of these localities, the variations being due to peculiarities of environment.

No. 4. Narcissus incomparabilis, the star narcissus, is a hybrid between Narcissus poeticus and Narcissus pseudo-narcissus, and is found in localities in which both these species are wild. Mr. Storrie records having found it at Pencoed. I have searched at this spot, but have failed to find it; moreover, there are no plants of Narcissus poeticus growing near, and I cannot, therefore, help coming to the conclusion that what Mr. Storrie found was rather some variety of Pseudo Narcissus. It is true the plant was commonly cultivated in gardens formerly, and it may possibly have escaped from some garden hard by. It occurs as a wild plant in Spain, S.W. France, and the Tyrol.

The other lists of plants of the South Wales district with which I am acquainted are:—1. "On the Botany of South Pembrokeshire," by Charles C. Babington, M.A., F.R.S., Professor of Botany in the University of Cambridge. Reprinted from the "Journal of Botany" for September, 1863. 2. "Botanist's Guide through England and Wales," by Dawson Turner and Lewis Weston Dillwyn, 1805. 3. "Contributions towards a Catalogue of Plants Indigenous to the Neighbourhood of Tenby," by R. W. Falconer, Esq., M.D., 1848. 4. "Six-Monthly Flora (Glamorganshire, but chiefly the Neighbourhood of Cardiff)," by Miss C. E. Ollivant, published in the Transactions of the Cardiff Naturalists' Society, Vol. V., 1873. 5. "Materials for a Fauna and Flora of Swansea and the Neighbourhood," by L. W. Dillwyn, F.R.S., &c., 1848. This has a list of the rarer flowering plants found within 20 miles of Swansea. 6. "The Swansea Guide for 1802," by the Rev. John Oldisworth. This contains a list of "Rarer Vegetables," in which there is no mention of Narcissus.

Dillwyn and Turner's Guide makes no mention of Narcissus.

Miss Ollivant's Flora contains the following reference:—*Narcissus pseudo-narcissus* — Common daffodil, &c., field near Coedriglan.

Dillwyn's Fauna and Flora has—Narcissus biflorus. Mr. Bicheno informs me that it grows in abundance in Kenfig village, not far from the church. With an equal claim to be placed in the British Flora, N. incomparabilis grows in the little Park at Margam, and Mrs. D. Llewellyn has shewn me good ground to believe that it has continued to do so for at least two centuries. In like manner, M. (surely a misprint for N.) *minor* thrives on the rocks below the old castle at at Penrice, and no trace can be obtained of the time when it was planted there.

Dr. Falconer, who practised medicine in Tenby until 1847, gives, in his catalogue, under Amaryllidaceae: "Narcissus pseudo-narcissus, daffodil, common near Holloway Farm, near St. Florence." It is probable that this refers to the Tenby daffodil, Narcissus lobularis or obvallaris. Indeed it seems proved by Mr. F. L. Arnett's letter, January 17th, 1893, wherein he says: "On some fields belonging to

Holloway Farm the daffodil (Tenby) grew *very* abundantly." Prof. Babington's visits to Tenby were made in the summer, and this probably accounts for the fact that he simply mentions Dr. Falconer's observations respecting the Narcissus. This completes the bibliography of the subject, with the exception of references to the Tenby daffodil, which will be found later.

Mr. Fred. Walker, of Tenby, writes me February 4th, 1893: "We have four species of daffodil growing here in a wild state—viz. : Narcissus biflorus, poeticus, pseudo-narcissus, and lobularis, or, as it is now called in the trade catalogues, 'obvallaris,' the last used some five-and-twenty years ago to literally cover some fields in the immediate neighbourhood; but now, thanks to the depredations of visitors, and the greed of the occupiers of the land, who have been sending off truck loads to the dealers, it is becoming scarce, and ultimately will, no doubt, like many other good plants, once common here, become extinct."

A noble variety of Narcissus incomparabilis, the Star Narcissus ("Sir Watkin"), was discovered in 1883-84 on the estate of a Mr. Picton in North Wales. The origin of the plant is quite unknown; but the chances are that it was a garden hybrid which originated spontaneously, and remained unnoticed until the fashionable craze for these flowers began. Mr. Thomas H. Thomas tells me he saw some of the flowers in a wreath at Llanrwst in 1888, and was informed by the townspeople that they believed it to be a country daffodil.

To these are to be added also two double varieties,—viz. : a double variety found growing with the Tenby daffodils at Tenby. Mr. J. E. Arnett, of Tenby, writes April 3rd, 1893: "Yesterday I found a few roots of the double daffodil at Knightson. This flower grows by itself in a very secluded spot, quite away from any dwelling." Speaking of the same plant, Mr. Burbridge writes : "Some years ago, Mr. T. H. Thomas sent me the comparatively rare double English daffodil (Narcissus pseudo-narcissus flore pleno) from Cardiff, but exactly where he got it then I do not know. Previously it had only been known to me from the Isle of Wight, where it has long been known in Centurian's Copse (St. Urian's Copse) and from Devonshire (near Newton Abbott). It is curious that a plant wild from Cornwall to Fifeshire, should be so rarely met with in a 'double state,' but even Homer's Narcissus tazetta, of which there are hundreds of varieties and phases in the Mediterranean region and eastward to Cashmere, China, and Japan, is only represented by two 'double' flowered forms,—viz. : 'double Roman' and 'double Chinese.' Possibly Mr. Thomas obtained his plant from a garden."

The other double daffodil to be enumerated is styled by Mr. Burbidge "Thomas' Virescent Daffodil" of Penylan, so named after Mr. Thomas H. Thomas, of Cardiff, who first noticed it. It does not fall exactly under the descriptions of any of the known varieties, and it appears to be as interesting in its way as the Tenby daffodil itself. It is found covering some two or three acres of a sloping meadow, with a south aspect, on

Narcissus incomparabilis, var : "Sir Watkin."

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Narcissus obvallaris-plenus (Thomas' Virescent daffodil, of Penylan).

the old red sandstone at the Chapel Farm, Penylan, near Cardiff. Mr. Storrie reports having found the same variety near Cottrell eight years ago, but so far as I can ascertain it is not found elsewhere. Its origin is quite unknown, but from the fact of this field having at one time probably been the site of a chapel it is likely that these plants are a relic of ancient cultivation, and that liking the soil and situation they have established themselves and have become thoroughly naturalized. The young blooms are virescent, some arrest of colour development takes place, and the flower becomes yellow very slowly. "It is," says Mr. Burbidge, "what I call the coronal phase of the plant,—*i.e.*, the coronal or trumpet segments are fully developed, and the perianth segments in part suppressed in their growth—sometimes the reverse of this is true, the trumpet segments are partially suppressed in growth, while the perianth whorl is most luxuriant, and the result is a larger and more rose-like and a paler yellow flower."

It is by no means a handsome flower, but gives an impression of degeneracy, and reminds one of the leaf-like reversions so common with the petals of polyanthus. It consists of from four to six series of coloured coronal segments, between each being a series of dwarfed greenish perianth segments—these are much smaller than the coronal segments and resembles leaves—the coronal segments themselves often take a more or less green colour, and the general effect is to give the flower a peculiar greenish or virescent appearance. In the centre are several modified stamens too confused for the accurate determination either of their rank or botanical position. Both pollen and ovules may be found occasionally. With the coronal segments there exist all sorts of gradations from the entirely undivided state to complete division into its less compound segments. In some instances the lobing is perfect and exactly resembles the lobing of the Tenby single daffodil, in others the lobing is continued to form clefts, and in others the cleft extends into a split.

As it is important to arrive at a definite conclusion as to what this plant is, I have submitted it to several authorities, and the following are their opinions. The Rev. C. Wolley Dod explains the plant as a form of Narcissus pseudo-narcissus, telamonius plenus (Van Sion). In so doing he says: "These plants vary much in appearance according to soil and other conditions. I believe it came in the sixteenth century to England from Italy, where it is wild; but it is a plant of such wonderful constitution that it readily makes a home for itself wherever it comes by accident. At the same time it is produced from seed, either of itself or of kindred varieties. Near Tenby a single daffodil *of a different variety* abounds, and with them are found doubles, which cannot be distinguished from those of Van Sion. I have little doubt that these are doubles of the Tenby daffodil, as I have raised similar daffodils from the seed of Tenby. It is probable that these double daffodils may have originated *independently* in several places, but though they seem to vary so much, the differences between them after being cultivated in the same soil for a few years are not as great as the

difference between flowers of one variety grown in different soils and conditions. I have had stunted dwarf flowers looking entirely different from the large double garden daffodil, which, after three or four years' cultivation, have assimilated with it in every respect."

Mr. Peter Barr writes thus : "18th November, 1892,—My best thanks for clumps of telamonius from Penylan, near Cardiff. I have ordered them to be planted with the other telamonius plenus I spoke about, and to remain for some years. I will thus see if all come to one thing or some differ. Parkinson records more double Narcissi yellow than *we know*, and, it appears to me, Wales may be able to account for the missing ones. I shall be glad if you can trace a double form of the Tenby—consider the leaf, the flower, the bulb, and time of blooming."

Mr. Burbidge says of this plant : Thomas' virescent daffodils are smaller in size, longer in stalk, later in time of flowering, and more decidedly virescent than any other double daffodils I have ever seen and I am beginning to doubt that they are really Narsissus telamonius-plenus, or 'Van Sion' of the Dutch at all."

Then, on the 21st April, 1893, Mr. Peter Barr, writing to tell me his opinion of the flowers from bulbs of Thomas' daffodil sent by me to him says of the plant : "It appears a dwarf form of double daffodil—should say the double form of obvallaris, with narrow foliage, flowers small and ragged."

As to the origin of these apparently wild or naturalized double forms of daffodils, nothing is better established than the fact that Narcissus pseudo-narcissus is one of the few British plants which produces double flowers in a perfectly wild state. Indeed, the committee appointed by the Narcissus Conference, summoned by the Royal Horticultural Society in 1890, reported that "sufficient evidence has been collected to substantiate the fact that bulbs which at one time produced only single flowers, might have previously produced, and might again afterwards, under certain conditions, produce blooms in all stages of doubleness." Parkinson, in his "Paradisus in Sole," page 103, speaking of the double Spanish bastard daffodil, says : "I think none ever had this kind before myself, nor did I myself ever see it before the year 1618, for it is of mine own raising, and flowering first in my garden. It is risen from the seed of the great Spanish single kind, which I sowed in mine own garden, and cherished it until it gave such a flower as is described."

"Lately," says Mr. Burbidge, "Captain Dorrien Smith sent me from Scilly a twin bulb of the Tenby daffodil, both divisions being included in one tunic, one half bearing a typical Tenby single flower, the other a large double telamonius. Again, Mr. Engleheart sent me, a few years ago, from Hampshire, a large number of seedlings from the large garden double and the wild single grown together, no other daffodil being near. These produced a remarkable variety of single and double forms in a series of varying size. I infer that a double daffodil, though occasionally a sport, is often as it were a new departure springing from seed, and that it does not of necessity follow the form of the seed

parent ; also that there is a tendency in the double seedlings of larger daffodils to assimilate to one type. The old belief that single forms removed to richer soil become double is not borne out by experiment."

Shirley Hibbard (*Gardeners' Magazine*, 1874) says: "The doubling of Narcissus is an interesting phenomenon. It is generally considered that doubling consists in the conversion of stamens and pistils into petals, and this undoubtedly takes place in the doubling of daffodils ; but the "petals" added to the original form usually exceed in number the organs regarded as their origin, and indicate not only a metamorphosis, but a multiplication of the several parts of this flower. If we count the outer segment of the perianth as six, and suppose the corona to consist of six lobes united, the stamens being six in number, the stigma three lobed, we have only twenty-one parts in all. We made an attempt to count the parts in a flower of the grandi plenus variety of the common daffodil last spring, and when we had counted (by pulling to pieces) sixty-six parts, we found a lot of scale-like processes at the base, and gave up the the task as too difficult." This is well seen in the Penylan double daffodil.

Lastly we come to the Tenby daffodil, Narcissus (Ajax*) obvallaris, the variety is quite sui generis, distinct from other daffodils in form, substance, and colour. The nearest to it are some Spanish forms, such as Narcissus Saragossa, so called from the locality where they grow, but they can be distinguished at a glance. The first mention of the plant is in Salisbury's Prodromus, A.D. 1796, page 221.

> 7.—Narcissus 1 florus, corollœ laciniis obvallaris tubo ½ longioribus, rectis, ovatis interioribus multo angustioribus valde imbricatis: coronâ infundibuliformi basi cylindraceâ 6-fidâ, repandodentata, superne plictaâ. Pseudo narcissus luteus. Best. Hort. Eystt. tert. ord. Mala communicavit.

Above is an extract from Salisbury's "Prodromus in Horto ad Chapel Allerton," 1796, page 221.

In a paper on the Narcissi by the late R. A. Salisbury, entitled "Cultivation of Rare Plants," published in the Horticultural Society's Transactions, 1812, Vol. I., pages 343 to 366, thirty-seven species and varieties are alluded to in separate paragraphs.

No. 5 is Narcissus, or as Salisbury has it, Ajax obvallaris—

> "Ajax obvallaris, MSS. Narcissus major γ Ker, in Bot. Mag., No. 1301, cum. Ic. absque foliis: Narcissus Sibthorpei, Haworth, in Linn. Trans., Vol. V., p. 243: N. obvallaris, Prod., p. 22: Pseudo narcissus-major. Hasponnic Clus. Hist. Pl. lib. 2, p. 165."

"The first time I saw this plant it was pointed out to me by Mr. Curtis,† as an indigenous species, which he had just received from Dr. John Sibthorpe.‡ To Oxford I set off the next day, where I was not a little disappointed to learn that, by a mistake of the gardener's, some bulbs of it, intended for Mr. Sole, had been directed to Mr. Curtis, and those of our wild species which Mr. Curtis wished to

* Ajax is simply a generic name given by Haworth to all "trumpet" daffodils.
† Curtis, editor and originator of *Botanical Magazine*.
‡ Professor of Botany at Oxford.

have from Noke Woods had been sent to Mr. Sole. By way of consolation, however, my late excellent friend loaded me with many plants, not then in my garden, and we spent a whole morning in examining Sherard's Herbarium; but no specimen of this plant was to be found, nor could he tell me anything about it, except that when his father, who was then absent in Lincolnshire, came to Oxford it was called 'Bobart's daffodil.' This name alone is sufficient evidence to my mind of its having been introduced by one of the Bobarts,* and probably by the younger, for it is not mentioned in the second edition of Catalogus Horti Oxoniensis, published in 1658. It used to ripen seeds at Chapel Allerton,† and succeeds best in damp loam. If L'Ecluse's synonym above quoted really belongs to this species, as I suspect, it grows wild in wet meadows of Castilla La Vieja. Mr. Kerr indeed in 1,301st number of the *Botanical Magazine* has added that to his more cautious predecessor's synonyms of grandiflorus; but L'Ecluse expressly says that the flower of his plant is less, and its leaves greener, than those of our indigenous daffodil. This synonym accordingly must be determined by some botanist resident in Castilla La Vieja, for in our gardens, grandiflorus, has not only a large flower, but the most glaucous leaves of any species yet known."

A monograph of the suborder v. of Amaryllideæ describing the narcissineæ, by A. H. Haworth, Esq., F.L.S., &c., page 3, 1831, contains the following:—

"No. 16, lobularis A. (Tenby six-lobed daffodil) corollœ laciniis luteis tubo obconico exacte duplo longioribus; corona perlutea patula sex-lobata (lobis integris) laciniis tres lineas superante. Note in Phil. Mag. May, 1830, page 131. This grows wild near Tenby, in Pembrokeshire, which by mistake was written Tenby, in Derbyshire, in the place above cited."

"No. 19, obvallaris A. (short tubed spread crown) corolœ laciniis tubo ½ longioribus, rectis ovatis, interioribus multo angustioribus valde imbricatis corona infundibuliformis basi cylindracea 6-fida repando dentata, superne plicata. A. obvallaris narc. reris 120. Narcisssus obvallaris—Salisb. Prod page 221. Narcissus major γ, Gawler in Bot. Mag. t. 1381, fig ima sine foliis."

"No. 18, Cambricus A. (the recurving lobed) corollœ laciniis lateris ovato-acuminatis tubo tertia parte longioribus, corona perlutea alto sexlobata, lobis patulis vix rugosiusculis plicato-crenatis recurvantibus. Communicavit amicus Dom Penny fine martii, 1831. Habitat in Cambria. Nova species vel fortasse precedentis varietas floram unum narcescentem solum vidi, page 5, ix. Queltia."

"3.—Incomparabilis q. (the great incomparabile) corollœ laciniis sulphuris, corona late campanulari lutea, ore valde patulo, lobis magnis crispo-undatium quasi imbricantibus. Narcissus incomparabilis. Bot. Mag. t. 121."

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* The Bobarts, father and son, were early curators etc, of the Oxford Botanical Garden.

† Chapel Allerton was Salisbury's own residence, in Yorkshire, prior to his living at Peter Collinson's old place, Mill Hill.

N.B.—Notes * † are my own.—[F.W.B.].

These then are the early descriptions of the plant, showing how it was known and figured as far back as 1796.

A modern and very good description of the Tenby daffodil is found in "The Illustrated Handbook of British Plants," by Alexander Irvine, F.R.S. Ed. Phytotogistele. Published by Thomas Nelson & Son, 1858. p. 327. "Narcissus lobularis, Haworth; segment of perianth, broadly ovate, and rather sharply acuminated (not tapering as in pseudo-narcissus). Cup (nectary Lin.), divided into six lobes, and of the same colour as the segments of the perianth. From the Rev. W. T. Bree, Allersby Rectory, who cultivated it in his garden from roots found apparently wild near Tenby, Pembroke, by the late Joseph Boultbee, Esq. (Bot. Gaz., p. 83, vol. iii.) There is also, I am informed by Mr. Burbidge, a good coloured drawing of the flower in Botanical Magazine, 1301 (lower flower only), vol. xxxii."

It will be noticed that there is some confusion about the naming of the Tenby daffodil. Salisbury, in 1796, gives it no name, but quotes as a synonym Narcissus luteus. Haworth's Narcissearum Monographia, London, 1831, which is regarded as the best authority on this subject in the first half of the present century, after describing Ajax lobularis, states: "This grows wild near Tenby," &c. Later on he describes as another variety Ajax obvallaris, and it is the description of this which exactly tallies with our plant. Moreover, there is a reference to a coloured plate which is exact. Fortunately, however, there is no difficulty in deciding as to Haworth's meaning, for he refers to the illustration in the *Botanical Magazine*, and the figure there tallies precisely, not with Haworth's description of Narcissus lobularis, but with his own description of Narcissus obvallaris. It is therefore only possible to conclude that Haworth was himself in error in giving the name lobularis to the Tenby daffodil. Mr. Peter Barr, writing me April 11th, 1893, in reference to Narcissus lobularis, says: "Haworth gives no habitat for this. He had confused the plants I think; and many years back I gave the name lobularis to a dwarf growing daffodil with a yellow trumpet and sulphur white perianth. It does not take very well to culture, and has long since been discarded by us. I do not think the plant I have named lobularis is exactly Haworth's, while his description is not Tenby daffodil. I have many times had to correct the use of lobularis as applied to Tenby daffodil; and as the proof is all in my favour, generally my correspondent has given way."

The confusion is still further increased in the latest books, thus—in the last edition of the London Catalogue of Plants, 1836, the plant is called lobularis pseudo-narcissus, v. lobularis, Haw Then, in the last edition of Sir J. D. Hooker's "Students' Flora," under Pseudo-narcissus is given,—variety, Narcissus lobularis Haworth (Narcissus Bromfieldii syn.) perianth and corona both lemon-yellow, corona distinctly six lobed. He then proceeds to say: "The Tenby daffodil (Narcissus cambricus, Haw.) scarcely differs. It seems unfortunate that the term lobularis could not have been retained. In the first place the characteristic feature of the Tenby daffodil is the well-marked six-lobing of its crown, and this is

called attention to by the term lobularis. As to obvallaris, it seems to be a term absolutely without meaning. Mr. Burbidge says: "I don't know the meaning of *obvallaris*, but Nicholson says 'trenched round.'"

We may take it for granted that the Tenby daffodil, which it has been shown was once so thoroughly and generally established or naturalized in Pembrokeshire, and especially in the neighbourhood of Tenby, was certainly not a "native" plant. How, and by what means then did it get to Tenby?

"It has been suggested," says Mr. Burbidge, "that it might have been brought to Pembrokeshire by a colony of Flemings * which is known to have settled near Tenby. Mr. Barr insists that it is a Spanish daffodil; but nothing quite like it has yet been seen, or sent from Spain or Portugal during recent years. The same plant has, however, been found naturalized near Gorey, County Wexford, Ireland, and it is a singular coincidence, if nothing more, that a colony of Flemings had also settled there."

The Rev. C. Wolley Dod, replying to my enquiry as to the probable origin of the Tenby daffodil, says: "In cases where daffodils are known to have grown wild for centuries, it is hardly possible, in the absence of written records, to say where they came from, or whether they are indigenous or naturalized. It is so very easy to naturalize daffodils on suitable soils, that even an accidental outcast from a garden may have been the origin of beds extending over several acres. Those botanists who have the widest knowledge of the geographical distribution of plants, consider that no members of the genus Narcissus is indigenous to the British Isles, except the typical wild single Narcissus pseudo-narcissus, though many varieties are found apparently wild in England, Wales, Scotland, and most of all in Ireland. As for the Tenby daffodil having been introduced by the Flemings, a theory which seems to find favour in some quarters, I think it a mere conjecture, because the Flemings came from a land famous for gardening and cultivated bulbs.

On the other hand, the Tenby daffodil has never been known in cultivation in the land of the Flemings. My belief is that it is more probable that the Tenby daffodil, and many other fine varieties common in Ireland, were introduced in the middle ages by the Monks into the gardens and fields of religious houses. They were brought, probably, from the parent establishment—generally from Italy—where those large varieties of daffodil are common. The Monks brought them partly for ornament, partly for "herbalist" purposes, in the same way as they introduced into our native botany many foreign medicinal plants. I think that Narcissus incomparabilis, Narcissus biflorus, Narcissus poeticus, &c., all belong to the same source

* In consequence of an inundation in Flanders, large numbers of Flemings came to England in 1106, and Henry I. sent them to Pembrokeshire. Mr. E. Laws, author of "Little England," writing May 1st, 1892, says: How astonished the 11th and 12th century ruffian man-at-arms, who was sent down here to kill or be killed, would have been if he had been told that he had brought with him a daffodil from his native land.

of introduction—all being natives of North Italy, and all established wild from time beyond record in many parts of Great Britain and Ireland."

On this point, Mr. Burbidge says Narcissi was carried about as rustic medicines long ere their beauty attracted attention. Galen thus mentions them, and Loiseleur des Longschamps, a French physician and botanist, wrote a pamphlet on them, and has many allusions therein to their medicinal virtues,—narcotic and emetic. All my reading goes to place plants in the following order :—

a.—1stly. Food plants.
b.—2ndly. Medicinal plants.
c.—3rdly. Clothing plants, *i.e.*, textile barks or fibres.
d.—4thly. Plants for beauty and associations, and in the main this order influenced their early distribution.

Religious houses abounded in Pembrokeshire in the middle ages, thus the Augustinians, the Dominicans, and the Knights of S. John of Jerusalem all owned houses in Pembrokeshire, and besides these were many other religious establishments. On Caldy Island are the remains of a fine monastry, which was a cell of St. Dogmael's, and Monkton Priory in Pembroke was a Benedictine house. In Tenby was the College of St. Mary's, a Convent of Carmelite Friars, founded 1399.

The only difficulty then which now suggests itself is that not even in Italy, nor indeed anywhere else, has the identical plant, the Tenby daffodil, been found; it is as has been said *sui generis*, and we must look for yet another theory to precisely account for it. In all probability it is a descendant of varieties introduced probably by the monks; but I believe, and in this I am supported by Mr. Barr, that it actually originated as an accidental hybrid at Tenby where the soil and climate suited and favoured it, and thus it became the dominant variety, gradually taking the place of all others.

This mode of origin is a well established fact, thus Mr. Burbidge in accounting for the origin of the Irish daffodils says :—

"My own view is that these so-called Irish daffodils, or their progenitors were introduced many years ago as garden flowers, just as they were introduced to England. The only difference seems to be that they have thriven better in Ireland, and in many cases have seeded spontaneously, and so reproduced themselves *with some little variety*. At any rate, the fact stares us in the face that from Irish gardens a dozen or more varieties have been introduced to England within the last ten years or so that have so far not been discovered; either wild or cultivated elsewhere."

In another place he remarks that even the wild forms have been found to vary to a much greater degree than was supposed, and in many cases a complete chain of forms may be shown connecting two typical varieties which were used formerly to be considered totally distinct species (as triandrus and calathinus).

There seems, indeed, to be no doubt that daffodils readily perfect seed when placed in very favourable conditions; and the only strange point is that when they propagate in this way rather than in the more usual method of bulbing, the offspring tends to wide variation—sometimes a double will result from a single, or a single from a double, and all sorts of varieties may appear or even sports.

This is shown by the rapid increase which is taking place in the production of new varieties under cultivation; thus in 1629 only a hundred varieties of Narcissus are recorded; in 1888 the numbers had increased to three hundred and fifteen; and to-day the total reaches at least five hundred

Underground Water Circulation of Cardiff and its Neighbourhood.

REPORT OF THE RESEARCH SUB-COMMITTEE.

DURING the past session of the Society a Special Committee was formed to encourage research in various branches of science, and to bring more prominently before members of the Society those special subjects in the working out of which the Britsh Association required our assistance.

The Committee was enabled through the kindness of many friends

(1) To make a report to the Association on the Underground Water Circulation of Cardiff and its Neighbourhood, and

(2) To give assistance to the Committee which has for its object the Recording of Pre-historic and Ancient Remains of Glamorganshire.

One of our members, Principal J. V. Jones, has contributed an important paper, now published in extenso, giving an account of his researches in connection with the Committee appointed for Improving the Construction of Practical Standards for use in Electrical Measurements.

Your Committee considers that the work done is sufficiently encouraging to warrant them seeking re-election.

The report on the underground water circulation is appended.

The Committee desires to express its thanks to Mr. Storrie, Messrs. Isler & Co., Mr. Cooper, of Lower Penarth, Mr. W. Davis and others, for supplying valuable information respecting the underground water circulation, from which the following report has been drawn up.

In looking at the geology of the neighbourhood of Cardiff it will be seen that most of the strata are of the water bearing type.

Classifying them in the order of their importance they should be arranged as follows :—

(i.) Keuper sandstones and the Dolomitic conglomerate.
(ii.) Coal measures.
(iii.) Surface gravels.
(iv.) Lias.
(v.) Old red sandstone.
(vi.) Carboniferous limestone.

The strongest springs are usually found along fault lines, especially in the carboniferous limestone and lias beds. A good example occurs near Sutton, from which Bridgend derives its supply. Innumerable small springs are met with on the outcrops of the old red sandstone and coal measures owing to the variable succession of the strata where clays underlie sandstones and hold up the water contained in those beds. Thus every coal seam with its underclay may give rise to a line of springs along the outcrop.

Cardiff itself, like every other town similarly situated, has in past times derived a fair supply of water from the beds of surface gravel which appear never to be more than 50 feet in thickness. Whether or not they have been formed by glacial, river, or by marine action, it is noticeable that they vary much in character; and though they are very porous, the amount of clayey matter present reduces the rate at which water is absorbed, and still more the rate of delivery, in some cases forcing the water to escape to the surface in small springs.

Mr. W. Davis, of Cardiff, supplies an interesting fact in connection with two wells about 24 feet in depth, which were formerly on his premises in Queen Street. "About 22 years ago, a pipe containing some 120 gallons of oil was placed in the warehouse on a Saturday. On the following Monday the oil was found to have all leaked out and to have soaked into the wells, which were then pumped dry, but to his surprise, for several weeks other owners of wells in the neighbourhood brought him samples of oil and water which they had obtained from their wells, some being of opinion that they had struck an 'oil well.' The area over which the oil was distributed was not ascertained."

Though wells are numerous enough in these beds we believe very few of them are in use, and we sincerely hope none are for drinking purposes.

A point of great interest arises as to the effect of tides on the amount of water in the gravels of the low lying ground near the Taff and other rivers, and still more in the made ground.

We hope to make some observations on this point at a future date.

Near Cardiff the gravels usually lie on Upper Triassic (Keuper) clays.

The clays are red in colour, marked occasionally with green spots, which sometimes develop into definite bands, while the sections at Penarth show irregular bands of gypsum. Small crystals and fragments of selenite are common in the marls brought up from the well borings,

and besides these, occasional bands of sandstone and conglomerate are met with, one of which (at the Phœnix Brewery Boring in Working Street) was found to contain particles of gold, as recorded by Mr. Storrie in the early part of this year.

Beneath the marls is the Dolomitic breccia, better known locally as the Radyr stone. This rock varies much in character, but usually consists of angular fragments of carboniferous limestone, occasionally of old red sandstone and coal measures, set in a cement which may be magnesian, calcareous or clayey.

It is questionable whether the bed found at Radyr on the surface is exactly the same as that which underlies the red marls at Cardiff; still we are led to believe that on the planed surface of older rocks, at the beginning of the Keuper period, a bed of breccia was spread out, varying with the shore line in character. It is not, however, safe to predict merely because red marls are seen on the surface, that the breccia or water bed will be found beneath. This does not follow of necessity, as can be proved on Penylan Hill, where red marls lie directly on silurian strata, and again at Newport, where they succeed the old red sandstone.

The borings in these rocks derive their water from two horizons, one of which has not yet been properly gauged. I refer to the upper sandstone band, from which, under Mr. Storrie's direction, a supply of over 1,100 gallons an hour was obtained at Messrs. Anthony's Brewery in Frederick Street.

It is very remarkable that borings have failed entirely to strike the horizon, though driven within a short distance from a well in which water has been found on the height of the sandstone. The same workmen who did the sinking at Frederick Street failed a few months later to obtain any water from that depth, though, we understand, they were looking for the particular bed.

The bed is about three feet six inches in thickness, and derives much of its water, according to Mr. Storrie, from the Channel by percolation, which accounts for its extreme salinity, and also for the well marked ebb and flow within a range of five feet in some of the wells.

This water is made use of in some of the wells sunk to the lower bed, as at the Old Brewery in St. Mary Street. Analysis shows that the proportion of salt is in some instances above the limit permitted by the Act relating to brewing. With extreme care, however, it has been found possible to keep out part of the water coming from the sea, as in the Frederick Street boring.

The lower and better known horizon is the surface and upper beds of the Dolomitic breccia, especially the band, which lies about thirty feet above the conglomerate, generally called the "water bed."

There seems to be no record of a failure to obtain water from this band.

The number of wells in Cardiff increases, but the quantity of water does not seem to be affected as a whole.

The water from the Trias is usually hard. Analysis of the water at Lower Penarth proved the presence of $CaSO^4$ almost to saturation point, of $CaCO^3$, magnesian salts, and also NaCl.

The supply from the lower zone contains relatively a much larger proportion of magnesian salts.

The tables appended will give an idea of the depth of the wells and the character of the water bearing strata.

It is impossible to predict before hand the exact depth of the beds containing the water, owing to the irregular deposition of the breccia—in banks rather than in beds.

It may be, that owing to this arrangement, minor basins or cavities are formed, in which large volumes of water collect. Such a cavity may exist in the Dumballs area, where a very deep boring failed to secure an adequate supply, the bed having been reached only to be again plugged by an accident to the boring tool.

A boring, still in progress, at the Crown Preserved Coal Company's Works, Cardiff, has been driven through 700 feet of strata belonging to the Keuper series. This section of Triassic beds is the thickest as yet proved in South Wales.

Of the old red sandstone we know but little. From the evidence afforded by the Llanishen boring, it is plain that there are bands of conglomerate and open sandstones which may yield a very large supply.

WELL AT MESSRS. BIRD & SONS' WORKS, EAST MOORS, CARDIFF.

	Feet.	Inches.
Dug well	22	0
Pebbles	12	0
Loamy Marl	10	0
Marl	57	0
Blue Marl	7	0
Marl	113	0
Marls and Gypsum	7	0
Marl	118	0
Rock	3	0
Red Marl	4	6
Conglomerate	—	
	353	6

Lined with 25 feet of 11½ inch tube, top of which is 22 feet below surface and 100 feet of 10 inch tube, top of which stands 21 feet below surface.

Water level 32 feet below surface. Supply (1894) 1,500 gallons an hour. Water first touched 150 feet from surface.

Temperature 53°F.

Another well, 347 feet deep, was sunk previously, but was abandoned through an accident to the boring tool. It is near enough to be affected by the above, and water can be pumped from it with equal ease.

Copper Works, East Moors.

	Feet.	Inches.
Clay, Gravel, etc.	38	0
New Red Marl...	155	0
	193	0

Boring 16 inches diameter.
Temperature 54°.

County Brewery, Dumballs.

	Feet.	Inches.
Red Marls	372	0
Conglomerate	46	0
	418	0

Boring 5 inches in diameter.
The crown of the boring tool broke and choked the well, which was then abandoned.

North's Well, Bute Street.

285 feet deep.
16 inches diameter.
Temperature 53°.

Bute Well, Tyndall Street.

340 feet deep.
18 inches diameter bore.
Temperature 54°.
Supply 200 gallons per minute.
(See Cardiff Naturalists' Proceedings I. 35).

Well at Messrs. Brain & Co.'s Old Brewery, St. Mary Street.

	Feet.	Inches.
Pit	10	0
Gravel	15	6
Red Marl	253	6
Rock	1	0
Red Marl	21	6
Grey Rock	19	9
Red Marl	10	3
Conglomerate	3	0
	334	6

Lined with 30 feet of 8½ inch tube, top of which is 9 feet 9 inches below surface, and 166 feet of 7¼ inch tube, top of which is 9 feet 6 inches below surface.

Supply 2,600 gallons per hour.

Water level 26 feet 6 inches below surface (in 1882, 40 feet below surface before pumping).

Pump placed at 120 feet from the surface.

Temperature 53°.

Boring at Messrs. Hancock & Co.'s Phœnix Brewery, Working Street, Cardiff.

	Feet.	Inches.
Dug Well	20	0
Marl	38	0
Rock	2	6
Marl and Rock	65	6
Marl	109	0
Marl and Rock	7	6
Marl	20	6
Rock	2	6
Marl	20	6
Rock	1	9
Red Rock	2	6
Marl, with Gypsum	—	

Not completed.

Boring at Messrs. Anthony & Co.'s Castle Brewery, Frederick Street, Cardiff.

	Feet.	Inches.
Dug Well	5	0
Marl	2	0
Clay, with Boulders	3	0
Clay and Pebbles	10	0
Red Marl	23	0
Rock	2	3
Red Marl	17	9
Rock	3	6
Red Marl	53	6
Sandstone	—	
	120	0

Lined with 45 feet of 8½ inch internal diameter tubes, top of which stands 8 feet 6 inches below surface, and 115 feet 7¼ inch internal diameter tubes, top of which stands 3 feet 6 inches below surface.

Water level 21 feet below surface.

Supply over 1,080 gallons per hour.

Boring at the Rhymney Railway Station, Cardiff.

	Feet.	Inches.
Dug Well	62	0
Red Marl	88	0
Rock	27	0
Conglomerate	13	0
Red Marl	9	0
Rock	137	0
	336	0

Lined with 30 feet of 8½ inch tube 53 feet below surface, and 120 feet of 7½ inch tube 51 feet below surface (100 feet of latter perforated).

Water level 39 feet from surface.

Originally the well was not so deep.

Section of Well at Messrs. Owen & Co.'s Paper Mills, Ely.

	Feet.	Inches.
Pit	6	0
Made Ground	10	0
Sandstone	8	0
Gravel	10	0
Rock	8	0
Red Marl	14	0
Rock	41	0
Red Rock	4	0
Hard Red Marl with rock bands	7	0
Hard Rock	2	2
Hard Red Marl	14	10
Hard Red Marl with rock bands	6	0
Rock	1	0
Red and Green Marls	0	6
Hard Red Marl	6	0
Hard Red and Green Marl	4	0
Grey Rock	8	0
Red and Green Marl with rock bands	2	0
Rock	1	6
Grey Rock	7	0
Rock	39	2
Grey Rock	3	10
Hard Rock	20	0
Blue Rock	4	6
Hard Rock	21	6
	250	0

Boring at Ely Brewery.

	Feet.	Inches.
Dug Well	7	0
Ballast and Sand	17	0
Marl and Pebbles	10	0
Marl and Stone Bands	8	0
Hard Stone	34	0
Red Marl	54	0
Rock	17	8
Marl	2	6
Rock	4	2
Breccia	25	0
Limestone	1	3
Radyr Stone	13	11
	194	6

Well at Cogan Brickworks. Sunk in 1885.

	Feet.	Inches.
Red Marl with grey bands	201	0
Green bands	1	0
Red Marl	110	0
Green Marl	1	0
Red Marl	25	0
Coarse Grit	9	0
	347	0

Lined with 4½ inch diameter tube.
Temperature 53°.

Boring at South Wales Portland Cement and Lime Works, Lower Penarth.

Ground Level.

	Feet.	Inches.
Bottom Lias	10	0
Laminated Black Shale	0	6
Blue Clay	0	4
Paper Shale	1	2
Hard bluish stony Magnesian Marl, with much Pyrites	6	6
Stone...	0	3
Marl	2	0
Stone...	1	0
Marl	0	8
Stone...	0	2
Stone...	0	1
Stony Marl	1	3
Stone...	0	3
Carried forward	23	10

	Feet.	Inches.	
Brought forward	23	10	
Stony Marl	3	0	
Stone...	2	6	
Shale...	0	11	
Stone...	0	1	
Shale...	3	10	
Stone...	0	1	
Marl	2	3	
Stone...	0	6	
(Strong Sulphurous Spring).			
Hard Shale	6	8	
Stone...	0	2	
Shale...	0	8	
Stone...	0	2	
Marly Shale	3	10	
Light Stone	0	6	Marlstones. No Water or Fossils.
Dark Stone	0	8	
... ...	0	11	
... ...	3	0	
Light Stone	0	11	
Dark Stone	0	7	
Very hard dark blue and light green Stone ...	14	6	
Light and White Marl	9	8	
(Much water, probably 2,000 gallons an hour).			
Hard Red Marl	0	2	
Whitish Hard Marl	13	0	
Stony matter, greenish Marl, Gypsum, and hard red Marls in thin bands ...	7	9	
Red Marl	106	0	
(Very much water from Gypsum bands).			
Thick Gypsum band	—		
	193	0	

The water level is about 51 feet from surface, but varies much within limits of 25 feet.

There is a regular ebb and flow within limits of 4 or 5 feet.

Chemically it is very highly charged with calcium sulphate (almost to saturation point), and also contains $CaCO_3$, $MgSO_4$, NaCl, $MgCl^2$.

Lined with 153 feet of 5 inch perforated tubes, which stand 1 foot above bottom of sunk well.

Biglis, near Cadoxton.

	Feet.	Inches.
Soil	1	6
Light-blue Clay	1	6
Peat	3	0
Light-blue Clay	1	0
Red Marl	4	6
Hard Red Marl, rock at bottom	10	9
Hard Grey Marl and Rock	8	0
	30	3

Surface level 23·8 feet above ordnance datum.

Well at Mr. E. T. Lyddon's House, Llanishen.

	Feet.	Inches.	
Clay and Stone	10	0	
Coarse Gravel	6	0	
Running Sand	2	0	
Coarse Gravel	5	0	
Red Gravel	5	0	
Sand	1	0	
Red Gravel	5	0	
Red Marl	6	0	
Red Sandstone	9	0	
Conglomerate	1	0	
Red Sandstone	2	0	Old Red Sandstone.
Conglomerate	2	0	
Red Sandstone	11	6	
Stiff Red Marl	1	6	
	67	0	

Lined with 40 feet of 4 inch tube. Water level was 23 feet from surface. Water struck at 47 feet.

F. T. HOWARD,

Hon. Sec.

Notes on the Tooth of a Species of Mastodonsaurus, found with some other Bones near Lavernock.

By J. STORRIE.

Read May 17th, 1894.

IN September last, when looking for aluminous clay for cement-making I was fortunate enough to find some remains of the great Labyrinthodon, *Mastodonsaurus*, the animal which has been credited with making the footprints, in the New Red Sandstone and Keuper beds, known to geologists as *Chirotherium*, from the likeness of the impressions made by its feet to those of a human hand. Twelve or fourteen years ago I noticed, on the shore not far from Lavernock, some very imperfect footprints, so imperfect in fact that they were all but unrecognizable, and I have always had hope that I might come on some trace of the actual animal, but until this present find had not been successful.

Their position is in a shaly marl under the second Marlstone bed, and about six feet under the Rhætic Fish bed, which is the very bottom of the Black shales; the Fish bed is about four to five feet lower than the Bone bed. The locality was near Lavernock, on the shore nearly abreast of the Ranny Point Buoy.

The specimen found was a large canine tooth, measuring about 2¾ inches in length by $1^1/_{10}$ inch in diameter at the base; neither the point nor the base however were perfect, and the tooth no doubt would be over three inches long when complete. It was highly pyritized, as you will observe under the microscope; but I have been able to cut several good sections, both transverse and longitudinal, and find that it differs from Professor Owen's well known figure only in being very

much more complicated in the labyrinth-like foldings of the dentine and cement. The whole of the canals can be traced from circumference to centre in the plainest possible manner, and form the most intricate example of dentinal folding I have ever seen.

The principal difference between the Lavernock specimen and the one figured by Owen is that the former has 84 ribs on the tooth, while the latter has only 48, and the Lavernock tooth has nearly double the number of dentinal canals, which are twice as much convoluted as in Owen's specimen. The actual size of both specimens seems to have nearly the same.

Whether the intricacy of the structure is due to the age of the individual to which it belongs, or whether it marks a new species, I am not at present prepared to say.

A curious thing connected with it is that in the pocket hole in the Keuper Marlstone in which it was found was a quantity of small teeth of sphærodus, pure white quartz pebbles, red jasper pebbles, rounded pebbles of limestone, unfossiliferous, but, probably, Lower Silurian greenish coppery mud-stones, and many other rolled and rounded pieces of material, exactly similar to the contents of the Rhætic Fish bed, and evidently nearly if not quite co-eval with it. All of this had evidently been transported from a great distance, and it will be interesting to discover the source whence the jasper pebbles, the silicified wood, and the immense mass of fish teeth and scales found with the Labyrinthodon remains have been brought; where was the district where this individual animal promenaded, and whether he died in combat with one or other of the great Saurian reptiles which swarmed in that remote era when the Trias Marls we see at Penarth were laid down.

I regret to find that the mandible found with the large canine tooth has no claim to be classed as Mastodonsaurus as I had believed; it is much more likely to belong to Palæosaurus, teeth of which I had already found in the Fish bed, about six feet higher in the series. Microscopical sections of the bone found along with the Mastodonsaurus, both longitudinal and traverse, are shown in the accompanying lithograph.

About twelve years ago, in nearly the same place, I found the remains of Trematosaurus, now at the museum; and about four years ago the two large teeth of Palæosaurus, which are now in my own collection.

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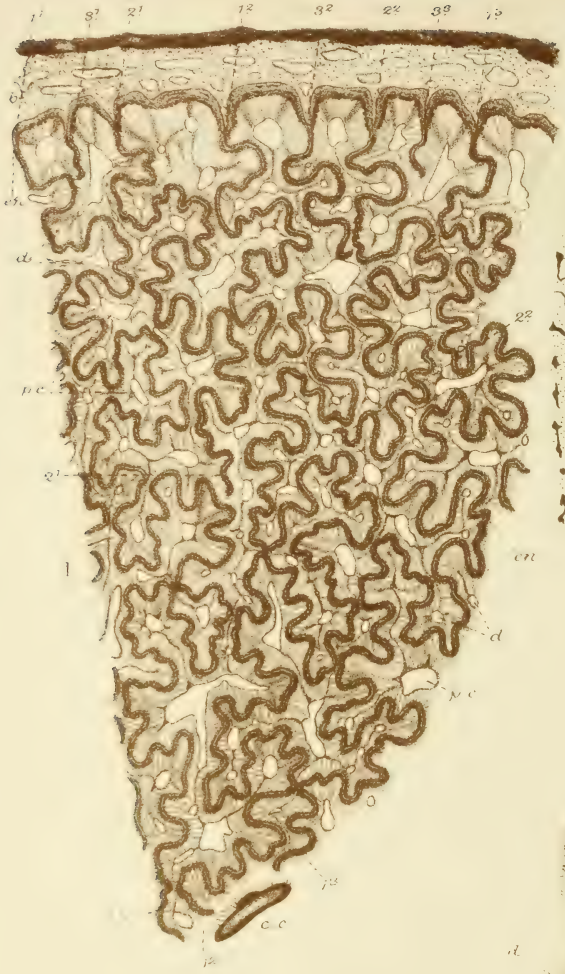

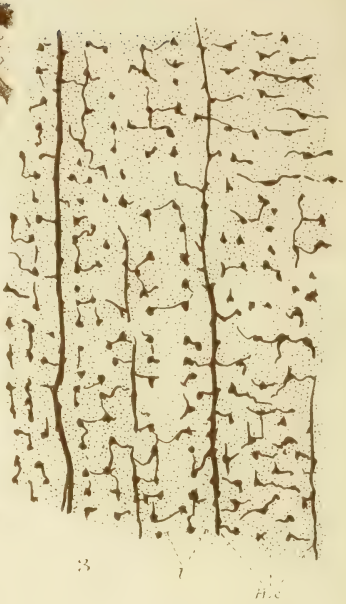

M.P. Parker lith. West, Newman imp

Figs. 1 & 2. Tooth of Mastodonsaurus, (? N. sp.)
" 3 . 4. Bone found with the above.

FIG. 1.—Transverse section of tooth of *Mastodonsaurus Nov. sp.?* The part represented is $\frac{1}{10}$ of the whole circumference of the tooth which has 84 inflections of the enamel + 10 diameters.

en.—Enamel.

d.—Dentine.

p.c.—Pulp cavities, the very irregular sizes and shapes will be noted.

c.p.s.—Central pulp cavity.

b.—Bone.

The section is cut through near the base of the tooth, but the dentinal canals do not vary in number from base to point.

1^1, 1^2 and 1^3, the longest and most tortuous inflections of the enamel towards the central pulp cavity, of which there are altogether

2^1, 2^2 and 2^3, half length inflections of the enamel.

3^1, 3^2 and 3^3, short inflections.

FIG. 2.—Longitudinal section, tooth of *Mastodonsaurus, Nov. sp.?* Cut through a pith cavity where it passes from one inflexion to another. + 22 diameters.

FIG. 3.—Transverse section of bone from waterworn fragment of humerus found with Labyrinthodont tooth.

h.c.—Haversian canals.

l.—Lacunae, very minute. + 40 diameters.

FIG. 4.—Longitudinal section of bone from foregoing. + 40 diameters.

The bone had been about $2\frac{1}{4}$ inches in diameter, and hollow, the central cavity about $1\frac{1}{4}$ inches diameter. The peculiar structure of this bone, and the fact of its having been found with the Labyrinthodont tooth, are the reasons for figuring it. The microscopic structure is nearer that of birds than reptilia.

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Notes on the Occurrence of Grains of Native Gold in the New Red Marl Strata during the Boring of an Artesian Well at the Phœnix Brewery, Working Street, Cardiff.

By J. STORRIE.

Read May 17th, 1894.

I HOPE no one will run away with the idea that I am going to proclaim a new boom in Welsh Gold Mining, and a means of getting rich suddenly by quarrying under Cardiff for the sake of the gold to be found there; still I think it is worth placing on record the fact that a small water bed in the New Red Marl strata, measuring not more than between four and five inches in thickness, and consisting of very fine sand, with an admixture of limy, marly clay, has yielded grains of native gold. The bed in question is at a depth of 334½ feet under the surface level.

The boring of this well was commenced over fifteen months ago by Messrs. Isler, of London, for securing a larger supply of water for brewing purposes, and the boring went on with varied success, owing to some of the beds being harder and tougher than had been expected, till, in February last, it was abandoned and the machinery taken away. After it had been sometime abandoned, I was asked by a friend whether I thought that if it were gone on with they would be successful in getting a supply of water; and on my answer being affirmative, a fresh contract was made with Messrs. Isler to go down further, and I was asked to look after the matter.

As I had not had the advantage of seeing any of the borings brought up during the former operations, I was quite in the dark when we started afresh as to what position in the New Red Marl strata we were in, and, consequently, I washed samples from every bucketful brought up, preserving everything except the very fine clay, and the result you will see in the boxes before you to-night.

During the time when the bore had been lying vacant it had become filled for sixteen to seventeen feet with debris, which had to be removed before anything could be done. We then started at a depth of 325 feet in the dark, tenacious soapy, marl, which soon changed to a fine stiff clay, dark in colour, and with but a small quantity of lime in its composition. In about four feet the clay gave place to harder marl; and at 334 feet the sandy bed was entered. In the second shellful I found the grains now seen, which were visible to the naked eye at the bottom of the glass in which I washed the samples. Unfortunately, the remainder had been thrown away before I noticed the gold, and although I have sampled each shell since raised I have not been able to get more. I believe it only occurred in the bed of sand, and was associated with iron pyrites,—which were rather abundant,—and fluor spar in very small pale blue cubes. Some sand of the bed is tinged red with iron; but under the microscope a large proportion of the grains are seen to be pure colourless quartz and mostly water rounded, but some are angular. The grains of gold are mostly rounded, very malleable, bright in colour, and apparently perfectly pure.

The question as to whence the gold has been originally derived is in my mind the principal one, and is beset with great difficulties, as the whole of the beds of the New Red Marl are so evidently the result of slow sedimentary deposit, that it seems quite startling to find evidence of a stream deposit among them capable of carrying grains of gold. I was almost led to infer that we had passed beyond the base of the New Red Marl and got into the top beds of the Radyr Conglomerate, which, of course, is known to have been stream deposited from the quantity of pebbles which enter into its composition. But later boring does not at present bear this out, as we are now going through marl indistinguishable from the ordinary New Red.

No white quartz rocks occur in *situ* anywhere near Cardiff, so far as I am aware, either with or without gold; yet colourless and milky quartz occurs in the form of sand and pebbles in the Millstone grit, the Radyr stone, the Rhætic Bone bed, where both red and white quartz pebbles are found, and in the Gravel drift, where pebbles of quartz are found which could not have originated in the Millstone grit, or any later strata at present known.

Now that the bed containing the grains of gold is known it will be looked for on the outcrop, and a better idea of its character will no doubt soon be known. As it must occur close to the transition from the Radyr stone to the Marl, it will be worth examining the sections at Lavernock, Sully, Dynas Powis, and Newton Nottage, where it is

possible that the grains are larger and more valuable, and their position more accessible.

It seems also remarkable that, considering the amount of chlorine and sulphuric acid in these rocks, the gold should not long ere this have been dissolved and dissipated.

I need scarcely say that during the further progress of the well I will keep a specially good look out for any further signs of the precious metal.

The boring is now discontinued, having reached the depth of 378 feet, no further indications of gold have been found.

Note on a Doubtful Species of Senecio.

By C. T. VACHELL, M.D.

Read before the Biological and Geological Section on January 18th, 1894.

DR. C. T. VACHELL showed specimens of *Senecio vulgaris*, var. *radiatus*, Koch previously recorded (Sir J. D. Hooker's "Students Flora") as occurring in the British Islands only in the Channel Islands.

Dr. Vachell stated that it is to be found growing abundantly in the Penarth district.

In order to exclude any possibility of doubt as to its identity, specimens of the plant were sent to Professor Hemsley, of Kew, whose reply was as follows:—"I cannot make anything of this but *vulgaris b. radiatus*. Will you let us have the specimens with Habitat?"

It differs from *S. vulgaris* proper only in having ray-flowers, with short ligules. At first sight it strongly resembles *S. viscosus*, but upon closer examination the peculiar sticky character of *viscosus* will not be found, and the two plants are easily distinguished by examining the achenes—in *S. viscosus* these are glabrous, whereas in *S. vulgaris*, var. *radiatus* the achenes are hairy.

St. Peter's, Peterchurch.

By WILLIS F. A. LAMBERT, M.A., Fellow of the Linnean Society, &c., Vicar.

(A paper written for the Cardiff Naturalists' Society, and read at the Annual Meeting, June 27th, 1894).

I HAVE been asked to give some account of our beautiful village church, where God has been worshiped since Norman times, and whose 'heaven directed' spire has adorned the landscape of the Golden Valley for some six or seven hundred years. Its telescopic form, making the interior in particular at once interesting and impressive, is so uncommon, that it is the more disappointing to find how little of its history can be traced except through its architectural features. Its origin and early history, like that of the old ruined castles in the parish, is wrapped in obscurity. This, however, you must expect in a county whose nooks and corners Canon Phillott, the author of the Diocesan History of Hereford, says are less known than most other parts of England, unless it is by couples on their honeymoons!

There appears to be no record of the date of the church's consecration. An extract from the Liber Llandavensis has been given me by Mr. Moore, the Hon. Secretary of the Woolhope Club, to the effect that, in the time of King Harold, Bishop Herwald consecrated Llan Peter, and committed the care of it to a priest named Colwyn; and it has been thought that this Llan Peter may be Peterchurch, and that the church was, therefore, consecrated in 1066. Peterchurch may very likely have been at one time Llan Peter, both names having the same meaning, just as Dewchurch, a village in this part of the county of Hereford, was formerly Llan Dewi. But, having looked at the Liber Llandavensis, I cannot find anything except the name to support this conjectured reference, nor does the architecture of the church in its oldest part seem to indicate quite such an early date as that of the

Conquest, nor does it seem at all probable that Peterchurch was ever in the Diocese of Llandaff. Most of the churches on the right bank of the Dore (the stream flowing by the west wall of the churchyard), and now in the Diocese of Hereford, belonged to the Diocese of St. David in 1831, and previously to Llandaff, the Dore being part of the boundary line of the Diocese of Llandaff in the time of Ondoceus. But this Church of St. Peter is on the left bank of the Dore, and has always, apparently, been in the Diocese of Hereford.

There are short references to Peterchurch in Blunt's manuscript, and in that of Mr. James Hill, who wrote in the commencement of the 18th century, and quoted from Blunt. Both these are in the library of Belmont Priory. But there is no notice in either the Walwyn (1746) or the Berrington manuscripts, nor does Duncomb's History of Herefordshire tell anything about the Golden Valley district.

In Blunt's manuscript, the date of which is given as 1640, it is said of Peterchurch: "This manor did of old belong to the Priory of "Malvern, for thus it was in King Edward I. time returned to the "exchequer, as did also the Rectory." This is the earliest record I have met with referring to the Advowson, and carries us back to 1272-1307.

The church has, as you see, an apse, double chancel, and a nave, an unusual combination, contributing much I think to its dignity and churchlike form. In the early Norman period the chancel of a church was often, if not generally, terminated by a round east end or apse. Around the outside of our apse is a rope-shaped string course—a similar ornamentation encircles the font—and this would seem to betoken a later date than early Norman. Newhaven Church, in Sussex, has the same style of apse, but not the double chancel, and the date of that church is given as about 1120. The buttresses, too, in both churches indicate this later period. "Early Norman buttresses are very flat, the greater "the projection the later they are as a general rule."* Compare the style and projection of the buttresses on the tower, which is early English with those against the apse, chancels, and nave. The buttresses on the tower are of quite different construction to those against the main building, while those on the nave are half as thick again as those on the chancels and apse.

On this ground I think that the explanation of the double chancel, is not, as has been surmised, that the church once had a central tower (there is no sign whatever of such a thing having existed), though that is found in Norman churches, but that originally it was only half its present length, consisting of what is now the apse and double chancel, and dates from the early part of the 12th century; that fifty years or so later the nave was added; and then, later again, say in the latter part of the 13th century, the tower and spire were built. Urishay and Snodhill Castles were then the proud strongholds of resident nobles who we trust united in this pious work.

* Parker's A.B.C. of Gothic Architecture, p. 32.

There is little ornamentation in the church, but you may notice the dog-tooth and zig-zag mouldings on the middle chancel arch, ornamentation on the abaci of both arches, and on the exterior of the apse windows and south doorway. The walls are massive, those of the tower being more than six feet thick. The narrow loop-hole windows with their steps are curious. The other windows have been introduced later, and are of the 13th, 14th, and 15th century styles of architecture.

An interesting possession of the church is what we believe to be the original stone altar, of which there are not many existing in this country. I will presently remove the covering that you may observe the consecration crosses. These crosses, five in number, respresent the five wounds of our Lord. There is a stone altar at Abbeydore (but without the crosses), which was used at one time as a salting slab, and was restored to its sacred place by Lord Scudamore in the reign of Charles II. There is also a stone altar in the chapel, or rather what was formerly the chapel, at Urishay Castle in Peterchurch, the place having been desecrated, and now used as a barn, and the Castle being a farm house.

The stone altar in our church is thus referred to by Mr. Bloxam in his work on Ecclesiastical Gothic Architecture (Vol. II., p. 140, 11th Ed.):—

"The high altar is still remaining at the east end of the apse of "Peterchurch Church, Herefordshire, with the five crosses incised "upon the slab, and on either side of the entrance into the apse is a "stone altar, probably the rood loft altars. Rood loft altars, or as they "were sometimes designated, altars of the crucifix, were anciently very "numerous. They were placed either westward of, and adjoining the "rood loft screen, or up aloft, and probably on the rood loft itself. "Besides the altars at Peterchurch, the only rood loft altars I have met "with existing in this country are two beneath the rood loft in the little "Church of St. Patricio, near Crickhowel, South Wales; one placed on "each side of the entrance into the chancel, westward of and against "the screen supporting the rood loft."

Three altars then apparently existed in the church in or since about the year 1829. It is evident where a second altar has stood—namely, where the pulpit now is. This is seen from the position of the piscina. As to the existence or position of a third altar nothing remains to visibly substantiate Mr. Bloxam's description. At the foot of the rood loft staircase is a niche which may be thought to have been a piscina, indicating, therefore, an altar; but I think this was probably an ambry, a cupboard for keeping the sacred vessels in, as I can find no trace of any drain in it. These receptacles are usually found on the north side of the altar, piscinas always on the south side.*

The south doorway is, no doubt, the original main entrance. That which is now used, namely, the north doorway, is of the same date

* Parker, p. 166.

as the Tower (1272-1300). "Doorways of this time are frequently large "and very richly sculptured, but in small churches they are "frequently plain, and have merely a dripstone over them,"* like ours.

Before the last restoration, in 1869, there was a north porch, which is said to have been of no architectural interest. A sketch of the church in Hill's manuscript, and dated 7th July, 1718, shows this porch, also a cross in the centre of the churchyard, and a sun dial. The cross has wholly disappeared, and only the base of the sun dial remains near to what was formerly a principal entrance to the churchyard, opposite the almshouses.

The present porch was erected six years ago (1888), as the parish's memorial to the Jubilee year of the Queen. It is in the Decorated Style, in harmony with the doorway and the tower, and as will be seen from the windows and the ornamentation of ball-flowers and four-leaved flowers; and the dripstone over the entrance is terminated, as those of this style often were, by heads of a Bishop and a King, in this case a Queen,—not, as one of my parishioners thought they were, or should have been, the likeness of the present vicar and his wife!

You will observe, over the interior of the south doorway, a stone tablet with the figure of a fish carved on it, and round the fish's neck is a gold chain. In Hill's M.SS. it is referred to thus:—

"On the west wall, on the inside of the church, is the image of a "fish in *alto relievo*, formerly painted with a gold chain about his neck. "It was placed here, as parochial tradition informs, in memory of a "fish taken with a gold chain about his neck in the very fountain from "which the river Doire taketh its original."

Your programme suggests that the Golden Valley derived its charming name from *dwr*, water; the valley of the Dwr or Dore becoming transformed by the Normans into Val d'Or, or Golden Valley. This is the philogical explanation. Some think that it has won the title on account of its fields of daffodils, its carpet of buttercups, or its waving corn. This may be the popular idea. But in the legend of the Golden Valley we have, at any rate, a poetic halo. A native of Peterchurch caught a trout of exceptional size and beauty, and lo! round its neck a band of gold.

There is a peal of six well-toned bells, four of which are dated 1782. The tenor bell is probably much older. Its weight is given as 11 cwt.

The fine chiming clock is the latest costly addition we have made to the church. It was subscribed for and placed in the tower nearly two years ago, and its erection was stoutly objected to by one of the principal farmers and landowners on the ground that it would enable the labourers to know the time!

We are now about to commence at once the work of re-laying the whole of the church roof, and re-pointing parts of the tower and spire, a work in which we have been much helped by a generous bequest of the late patron of the living.

* Parker, p. 134.

A quaint little book on "Most approved and long experienced water-works," was written in this neighbourhood by Mr. Rowland Vaughan, and published in 1610. Mr. Vaughan was a gentleman of position living at Newcourt, between Vowchurch and Abbeydore. There are, I believe, only three copies of his work extant, each of which I have seen, and I have copied a good many pages. It contains a scheme for the irrigation and general prosperity of the Valley, "to make these grounds more fertile ten for one," interspersed with much that is curious and locally interesting. He calls the Golden Vale of Herefordshire "the pride of all that country, being the richest, and yet for want of "employment the plentifullest place of poor in the kingdom." These he desired to help by his irrigation works and by a mill, which is said to have been erected at a place called "the Forge" near here. He was patron of two livings, these being Peterchurch and Turnastone, which he desired to unite, "Tornastone having only one inhabitant." He was anxious to secure a famous preacher and appointed "a young minister, "having a good witte, a good memory and a pretty dribble of learning." He tells us that an old monk at the dissolution of Abbey of Doire came "and did expound without license, and did divide and sever the corps "of the word from the Spirit that at his end he left neither Protestant, "Puritan nor Papist;" and of a preacher who "ventured his life "sixteen times over the great river of Wye, and as many more up and "down a hugh hill lying in his way, the danger of the least of "which is able so to distract a good scholar's memory as to forget a "sermon well pend and no worse cond. I have wondered many times "of the young preacher who did but learn to preach the other day, how "he was furnished with one in the forenoon and another in the after." He mentions "a chappell for prayer" for all his "mechanicals" and "an almshouse to provide for the over aged." It is an interesting glimpse of the neighbourhood in the early part of the 17th century.

Previous to the last restoration, in 1869, the church had become shorn of much of its architectural beauty, and suffered like so many did from neglect or tasteless reparation, though I am loth to believe that true religion was at so low an ebb as some would have us think. "Omnia mutantur, nos et mutamur in illis." Let me, however, try to picture our church to you, as it was some forty years ago or less. The exterior was in bad repair, and much of it needed re-building. The spire was unsafe. The interior was in keeping with the exterior. The inner chancel was then blocked out from view of the congregation, and was only used for the holy communion. A lath and plaster and rubble wall, with a small doorway in the centre, filled up the archway, and an oak communion table, now in the vestry, stood in front of the stone altar. In the nave were, of course, square pews and the usual three-decker pulpit. There was a flat ceiling in place of the present open roof, and three, if not four, galleries. In that at the west end of church the singers sat, accompanied by a band of wind and stringed insruments, and later a grand piano was introduced. Against the north church wall was a fives court, and outside shutters were fastened to the

north nave window to protect it from the balls. Three of the fastenings to these shutters are still in their places. The Sunday and Monday after St. Peter's day (June 29th) is still regarded as the parish "feast," and those who can manage it have their first duck, green peas, and new potatoes then; while others have to content themselves with a rice pudding. In old days the "feast" seems to have been kept as a general holiday, and the churchyard to have been the centre of attraction. Games and fights were held there, and women spread their cloths and displayed their wares for sale on the flat tombstones. The "dog whipper's" office must then have been no sinecure, for there was an official whose duty it was to keep dogs out of the church and churchyard, and for whose payment an acre of land called "the dog acre" was left to the church. Generally, it was the business of the dog whipper to keep the congregation awake during the sermon, which he did very effectively with the aid of a ground ash stick. I do not know whether the dog whipper in Peterchurch had a similar weapon to that belonging to one parish. This was a long stick with a knob at one end and a fox's brush at the other. The knob gave a reminder to the men and boys, the fox's brush a gentler touch to the slumbering ladies or those who required deferential treatment. At Clodock, a few miles from Pontrilas, a pair of "dog tongs" for catching strange and suspicious looking curs may be, or might until recently have been, seen.

In the churchyard is a venerable yew tree, said to be 1,000 years old. Its girth is about 30 feet.

The oldest tombstone with a legible inscription has been placed against the vestry wall, and is in memory of the wife of the Rowland Vaughan already referred to. Several of the epitaphs are curious, and many contain very quaint or illiterate spelling.

The two following are strangely conceived:—

To Richard Cheshire (18

Sickness was my portion,
Physic was my food,
Grones was my divertion
Drugs did me no good
The Lord took pity on me
Because he saw it best
He took me in his bosom
And now my soul's at rest.

To the memory of John Draper, Blacksmith, who died 9th October, 1811, *aged* 39 *years.*

My sledge and hammer lie declined,
My bellows to have lost their wind,
My forge and vice is now decay'd,
And in the dust my body's laid,
My iron's spent, my coal is gone,
My nails are drove, my work is done.

I shall be pleased, as far as is in my power, to give, and especially so to receive, further information about the church. Can anyone here account for the tripple arching in the west wall, or give the origin and meaning of the radiating marks cut in the stone outside and to the right of the chancel door, or advise me whether the elder tree, enrooted in the trunk of the yew should, for the benefit of the yew, be cut?

A few Notes on Yowchurch Church.

By the Rev. J. O. BEVAN, M.A., F.G.S., Assoc. Inst. C.E., Vicar.

Read before the Society on Wednesday, June 27th, 1894.

YOWCHURCH (Dwr—or Ffawr—church) has had a lengthy record, though scarcely an historical one. It is a misfortune that the history of most of the churches hereabouts, and the life of the community which has given them their *raison d'être* is written, as it were, in water. To-day I am concerned solely with this sacred edifice which is dedicated to St. Bartholomew. Originally, it must have been singularly uninteresting, consisting as it did of a rectangle totally unrelieved by aisle, transept, or outward projection of a chancel. The only redeeming feature was constituted by the proportion of the length to the breadth which was particularly correct. In certain parts of the walls tufa stone was worked in, this stone, apparently, from its origin possessing a sacred significance.

The feature which now renders the structure interesting and unique, is formed by the 14 beams which are ranged along its walls unsymmetrically as to the windows. These are composed of oak trunks somewhat roughly squared. This is a prodigality, not so surprising in the early days as it would be now, as timber at that time, in default of easy means of transport would possess but little value, save for local building purposes. As to the use of these beams, or their architectural necessity, opinions are not agreed.

Was the building, originally, entirely constructed of wood, and were the walls ultimately removed, leaving but the framework and roof remaining? I think not. Wooden churches are old, small, and exposed to peculiar dangers from fire, storm, and the lapse of time.

Here, then, are indications that the woodwork is of the period of the early part of the 17th century. The condition of the timber—the style—the dates on the furniture—favours this conclusion. Yet, strange to say, the walls are sufficiently thick to preclude any thought that by the introduction of these beams it was intended to take off much of the weight of the roof. Indeed, in one or two cases the bottom of the beams is partially decayed, and the beam swings to a limited extent, thus showing that in these cases there is no super-incumbent weight.

Viscount Scudamore, a man of some local consequence, to whom the lands of Abbeydore Monastery were granted, took great interest in the repairing and restoration of the choir of that interesting monastic church. His example and influence, coupled perhaps with some substantial aid, seem to have availed to cause a wave of restorative energy to pass up the valley; and appearances point to the conclusion that the upright beams and supports of the tower of this church—if not the greater part of the roof—were set up about this time. Moreover, the date 1636—Abbeydore being completed about 1634—together with certain initials, presumably of the churchwardens, is found on a bench in the chancel.

The founder's tomb in the north wall of the nave, now bears no inscription.

The screen is an elaborate and a handsome structure. Lozenge-shaped boards at each end testify to the fact that it was set up by certain children to the memory of their parents. The carving on the side facing the west is interesting. Two figures—male and female—stand prominently out, and are believed by certain of our people to be portraits of Adam and Eve taken from life.

A face on the lowest cross beam of the tower frame-work should be observed. A thistle is carved on the beam itself above this, but may not be of the same date as the face, which, nevertheless, is presumed to be of the Jacobean or early Caroline period.

There are three bells of good tone.

Certain monuments within the church seem to have disappeared, even of late years. Those that remain are modern and call for no special notice. There is a brass fixed to the south-east beam within the sanctuary, facing east, inscribed to the memory of a Lord Arthur Somerset,—one of the sons of a former Duke of Beaufort,—who lived at Posten Court in this parish. He died there in 1743, aged 72. The court was formerly a manor house, and a pigeon cote is hard by; the north side is now pulled down, and the remaining portion converted into a farm-house.

The Registers of St. Bartholomew are comparatively modern, and possess no special interest.

The silver communion plate bears date 1693.

The situation of the church is at the south edge of the parish, and its churchyard is bounded by the river Dore.

At the south-east corner of the burying-ground stands a half-timbered house, formerly the vicarage. Many years ago it fell into

decay, and was exchanged, with its site, for that piece of ground on which the school-house now stands. Since the exchange it has been used for various purposes—a poor-house—a school—whereas now it is merged in the Posten Estate, and is converted into two cottages, a carpenter's house and shop.

During the vicariate of the Rev. B. Lowther, 45 years ago, the restoration of the church was proceeded with.

The roof then was flat-ceiled—both in the nave and chancel—a partition ran up from the top of the screen to this ceiling—the pulpit was situated two bays further to the west, and there was a west gallery, where were found the sackbut and the dulcimer.

Mr. Lowther caused the roof to be opened out and ceiled against the tiles, the beautiful timbers to be exposed, the east windows and the small window above to be fully set forth, the carving of the capitals and bosses to be accomplished. He also had the walls of the chancel denuded of plaster and pointed; the niche in the east wall above the altar repaired, and the large oaken cross you now see set up; the bell-cote to be raised and shingled, and the porch to be reconstructed. The shields he himself elaborately painted with the coat-of-arms of the various land-owners and vicars, and affixed to the beams and set along the top of the screen on both sides. The vestry too was set apart in his days; the whole building thoroughly repaired and led to assume its present appearance.

On the whole, this building presents a perfect example of a village church, and in the material and arrangement of its pillars, furnishes a unique specimen. I have occasionally heard rumours of two or three instances of a similar kind, but apart from distinctly wooden structures such as Denton and Greenstreet, I have not been fortunate enough to see them.

The Abbey of Dore.

By The Rev. A. PHILLIPS, Vicar.

Read before the Society on Wednesday, June 27th, 1894.

THE present building now standing of the Abbey Church of Dore is a very precious relic of the once stately edifice, belonging to the powerful Order of Cistercian Monks. The fine nave, of which only one arch and one pillar remain to tell of its former beauty, is gone. It consisted of eleven bays. Of the church that now remains there is a north and south transept, measuring 94 feet from end to end; presbytery, 55 feet; north and south aisles, and ambulatory. A massive modern tower raised over an old arch stands on the south side. The original tower (doubtless a short one) formed the centre of the cruciform fabric. The whole is of beautiful proportion, and most elegant architecture.

The carving on all the capitals is exceedingly rich, though much is hidden by the white wash of Puritan times.

The east end is very striking. The three lancet windows immediately above the three open arches have a grand effect. The late Sir Gilbert Scott pronouncing it to be most beautiful.

Our learned antiquaries are much divided about the time of its being built: Burton placing it in Henry I., Leland in King Stephen, and Dr. Tanner in Henry II. But what may appear to set this at rest is that Cooke Clarencieux, king at arms, mentions Walter de Scudamore, who in the 14th year of the reign of King Stephen gave a parcel of his ground, called Fulke's Mead, to the Abbey of Dore, whence it may be concluded that it was built not later than the middle of Stephen's reign. There have been many contradictory statements made as to the possible founder of this abbey, which are confuted by Camden and Dugdale. The former, speaking of Sudley Castle, says: The former lords, hence called Barons of Sudley, were of an ancient English race, deducing

their origin from Goda, daughter of King Ethelred, whose son Ralph de Maigne, Earl of Hereford, was the father of Harold, Lord of Sudley. And Dugdale, in his delineation of the same family, says: In Edward the Confessor's days was Ralph, Earl of Hereford, whose son Harold, in the time of William the Conqueror, had two sons,—John, Lord of Sudley, and Robert, which Robert, residing at the Castle of Eirias (a mile distant from Abbey Dore), took his surname from that place, near to which he founded the Abbey of Dore. The date may be fairly fixed at 1147.

At this period there were many large grants of land and gifts made to this abbey by noble families, chiefly the Alanes of Alansmore, the Cliffords, and the Lords of Kilpeck. From the few scattered records that remain, we find among the endowments that King John, in the 17th year of his reign, gave, granted, and confirmed, to God, and the Church of St. Mary of Dore, and to the Monks of the Cistercian Order there serving God, all that land which lieth between the water called "Dore," and the revulet which is called "Trivelbrook" *(Monast)*.

The granges mentioned here as granaries, for the supply of the abbey, are still in this parish, — Holling Grange, Dore's Grange, Morehampton, and Kingstone Grange.

This abbey being dedicated to the blessed Virgin there is no Lady Chapel, this being the usual order of Cistercian Abbeys. Of the parish church there is no trace, except that a field on a farm, "Black Bush," a mile further up the valley, for a long period went by the name of "Church Field," or "Church Yard." The farm is still known by the name of "Black Bush."

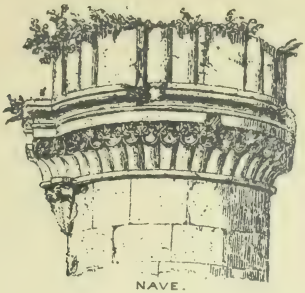
There are no remains of the Monastic buildings which stood on the north side of the abbey.

A small and very interesting portion of what was the Chapter House is still visible. On the dissolution of the religious houses this abbey with the parish church was suppressed, and suffered mutilation.

The site of the Abbey of Dore and demesne lands were granted to John Scudamore of Holm Lacy by the said grant, bearing date March 31st, Henry VIII.

The tithes of the parish from that period passed through several hands,—granted by Queen Elizabeth to Edward de Clinton, Earl of Lincoln, and Christopher Gough (gentleman), and by them sold to Richard Coppe, Esq., and by him sold to John Scudamore of Holm Lacy, from whom they descended to John, Lord Viscount Scudamore. The said viscount, who was an English Ambassador in France, is said to be the first to have introduced the red streaked apple into this county. When the property of Dore came into his hands the church was in a ruinous state; so much so that, in the reign of James I., the minister was forced to read the prayers under an arch so as to preserve his book from the rain.

Lord Scudamore finding no trace of the parish church, nobly set to work to restore and repair what was left of this beautiful abbey—viz., north and south transept, presbytery, north and south aisles, and



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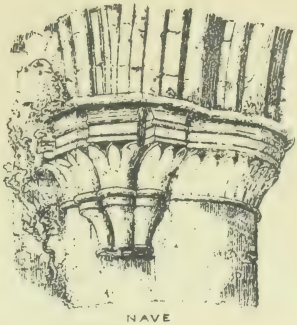

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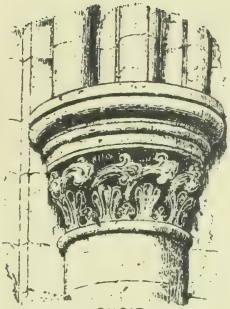

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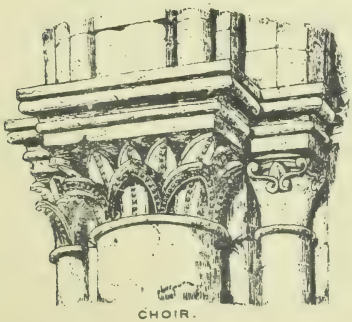

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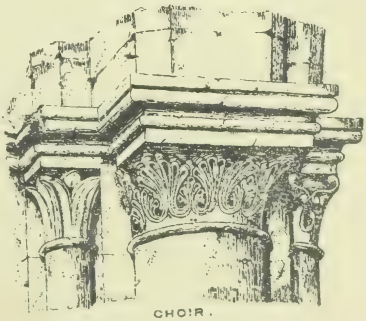

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From Sharpe's "Ornamentation of the Transitional Period."

DORE ABBEY.

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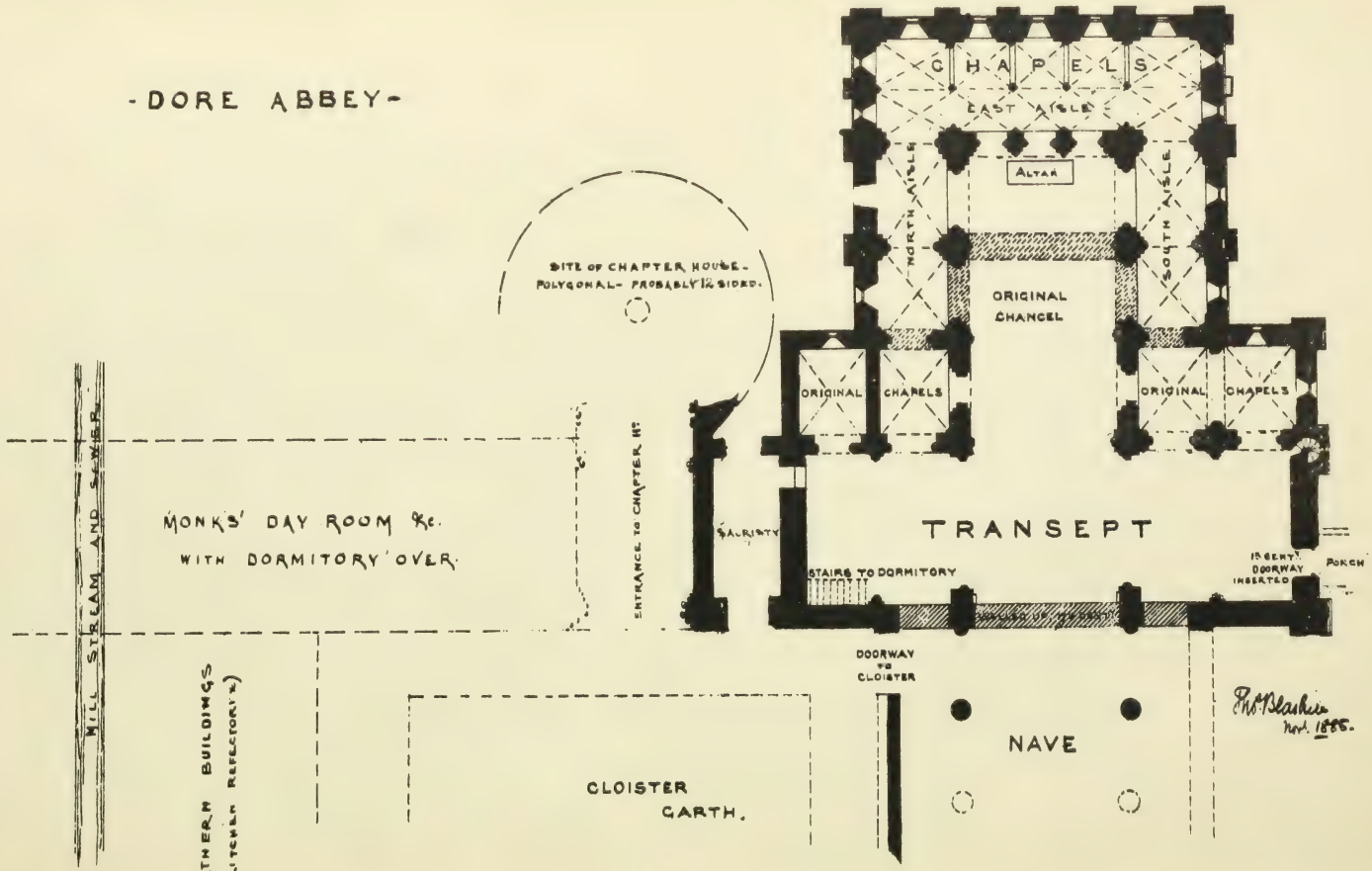

-DORE ABBEY-
CHAPELS
EAST AISLE
ALTAR
NORTH AISLE
SOUTH AISLE
ORIGINAL CHANCEL
ORIGINAL CHAPELS
ORIGINAL CHAPELS
SITE OF CHAPTER HOUSE - POLYGONAL - PROBABLY 12 SIDED.
ENTRANCE TO CHAPTER HE
MILL STREAM AND SEWER
MONKS' DAY ROOM &c.
WITH DORMITORY OVER
SACRISTY
TRANSEPT
STAIRS TO DORMITORY
15 CENTY. DOORWAY INSERTED
PORCH
DOORWAY TO CLOISTER
NAVE
CLOISTER GARTH.
NORTHERN BUILDINGS (KITCHEN REFECTORY &c)
Ph. Bleahis
Nov. 1885.

ambulatory;—the entire building was re-roofed and the present tower built. The whole of the restoration being in accordance with the style of that reign. The opinion of the late Sir Gilbert Scott (who visited this church a year before his death) was that the work of Lord Scudamore "was so noble and spirited that all he had done should, as far as possible, be respected and preserved." The height from the floor to the wall plate is 45 feet. The ceiling is flat, of lath and plaster between oak beams (Scudamore's work).

The altar slab, in the days of desecration, had been removed to a farmhouse, and used for salting meat upon; when discovered Lord Scudamore had it restored to its former position, re-consecrated, and set on three columns of stone, doubtless clusters of columns belonging to some part of the church. In addition to the high altar were five altars in the eastern chapels; beneath the altar are some interesting tiles of the 13th century, green in colour, and glazed, on which is inscribed a very elegant pattern. There is no trace of any early glass; that of the east window being of Scudamore's time (1634).

The centre light of the fine east window depicts the Ascension; above, Moses and St. John the Baptist; beneath, the eleven Apostles. The other lights on either side contain the Evangelists and four Apostles.

Every detail of this abbey is replete with interest; the more it is studied the more is there to be admired,—every carving and moulding is simply beautiful, and many of them rare and unique.

The monuments in this portion of the church are interesting. On the north side of the presbytery in a recess is the diminutive effigy of a bishop, 15in. in length and 9½in. in breadth at the top. The sides bear an inscription in Lombardic letters:—Ser(va) pontificis : cor . . sanctum . Xrstê : Joh.(anne) "o Xt. preserve the heart of Pontiff John." This commemorates John Breton, or de Breton, described as a man of great knowledge, and an ornament to his profession. He was Bishop of Hereford from 1269 to 1275. His place of interment is not known. This small monument covered his heart; his body was probably buried in his cathedral.—*(Roland W. Paul Arch.).*

On plain tombs, at the eastern ends of north and south aisles are two good examples of knights in chained armour. That in the south aisle is ascribed to "Robert of Eirias," the founder; and in the north aisle Sir Roger de Clifford.

On the front of the tombs are two carved bosses. They represent the crowning of the Virgin, and the Virgin and Child. On the north side is a door which led to the cemetery, on which is some beautiful old iron work, with scrolls and leafage, stated by Mr. Paul to be of the 13th century.

Behind the altar on a step is a portion of a shrine, found when making an excavation at the west end of the nave; it is a gabled canopy, which, when brought to light, retained bright gilding, but which, from exposure, soon disappeared.

This abbey stands in a very sequestered nook of the beautiful Golden Valley, midway between Hereford and Abergavenny, and $2\frac{1}{2}$ miles from Pontrilas Station (Newport line).

It has been thought that Abbey Dore is from the French *d'or*, because of the term Golden Valley; but golden is given to it, probably, from the richness of its soil, and the quantity of corn grown in former years.

Abbey Dore, or *Doyer*, the Welsh term for stream, has been variously written,—*door*, *dour*; and the British *dûr* the same with *ὑδωρ* (water) in Greek; hence the Welsh *doyer* (stream or water) points to the conclusion that Abbey Doyer, or Dore (as now abbreviated), means Abbey on the Stream.

Ancient Remains on Ely Race-Course.

Report on the Excavations undertaken by Mr. John Storrie on behalf of the Society.

AFTER the visit of the Cardiff Naturalists' Society to the Pre-historic Marsh Village at Glastonbury last year, Mr. Storrie made a number of excursions in this neighbourhood with the object of discovering similar remains. In the course of these observations he had noticed promising places near Marshfield and Caerphilly, and, afterwards, certain mounds upon the Ely Race-course. At the last named place he proceeded to make a number of trial holes, in some of which were found fragments of pottery, etc., sufficient to indicate the existence of ancient remains. Mr. Storrie at once saw Mr. George Thomas, of Ely Farm, who told him that the mounds stood in what was formerly known as the "Monachlog," and was believed by himself and other old inhabitants to have been the ruins of a monastery. He then communicated his views to the Cardiff Naturalist Society, and shortly afterwards the Committee of the Society paid a visit to the site, and made trial excavations of sufficient extent to make it certain that considerable Roman remains existed beneath the mounds. Consequently, the Committee determined to further investigate the matter, and, having obtained the requisite permissions from the land owner (The Rt. Hon. Lord Windsor) and his tenant, Mr. Storrie was instructed to proceed with excavations with a view to ascertaining the nature and extent of the remains. Accordingly, on the 30th May, work was started, with the assistance of a labourer, and continued until the 22nd of August. The plan adopted was the driving of a trench about 5ft. in width across the site from W. to E., which terminated when it had reached a length of 336ft., and from the remains discovered he arrived at the conclusion that the place formed the site of a considerable Roman Villa.

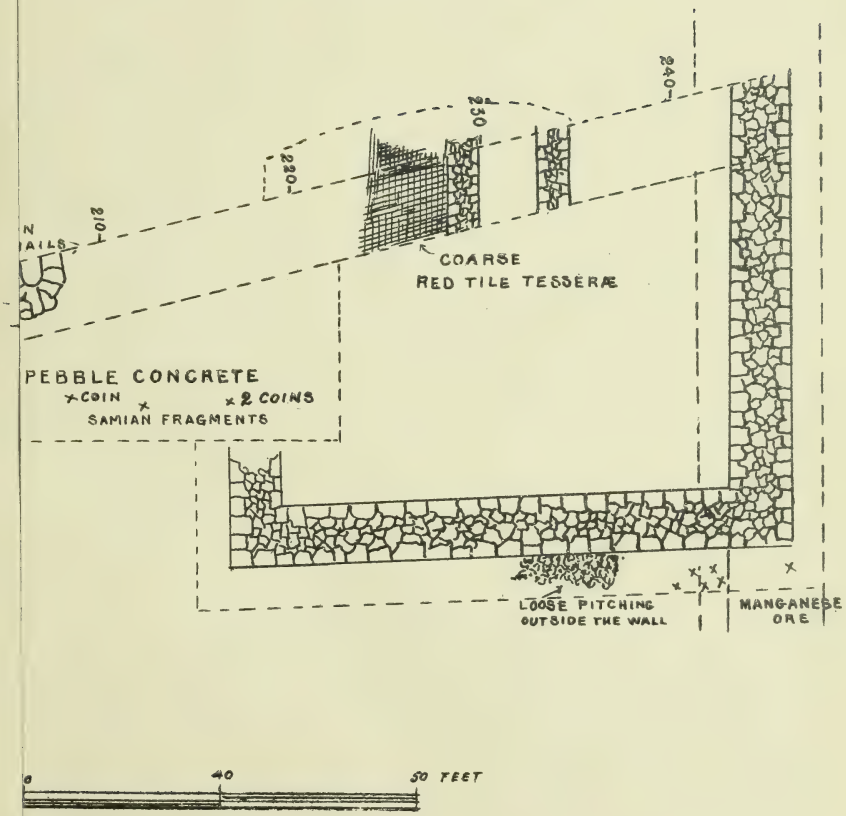
At the commencement of this trench a ridge was crossed which turned out to be a roadway formed of pebble-stones from the gravel, no doubt picked from the ground round about, and used for hardening the roadway which rose about 12 inches above the surrounding level. The stones were principally pennant, millstone grit, quartz, and a few flints. This was evidently the original roadway to the existing buildings on the site and was clearly traceable and straight as a line to Ely Bridge. At about 115ft. from the commencement, there was found the site of an outer wall of the villa, the stones of which had been rooted out to a depth of about 7 feet, and the squared stones carried off, while the rubbish was thrown both back and front. Large lumps of mortar were found, and thinner pieces of wall plaster, one piece painted with Pompeiian red, and several with the red and black spotty pattern found at Llantwit Major Villa, and produced by striking a brush charged with colour against a stick as book-binders sprinkle book edges. At 156 feet from the commencement of trench the excavator came on the first solid mortared wall. Its base was on the black stratum which was the original level of the ground. In this he found all sorts of rubbish, both vegetable and bones of animals, broken pottery, etc., pieces of red bordering cement which mostly goes round the edges of tessellated floors, as well as pieces of coloured plaster. In trying to find the general lie of the buildings, a wall was developed which had wall-plaster of a dull cream colour still adherent in some places. Mr. Storrie still continued to develop the site as shewn on the plan, thereby disclosing, but only to a limited extent, the general plan of the buildings. No trace of Medieval work was found, nor was anything seen during the working which would indicate Monastic remains. During the course of the excavations he came upon the evidence of a foundry—used for the production of iron. This is referred to in his report dealing specially therewith.

Annexed hereto is a list of the principal objects found during the work. A typical collection of objects has been made and handed by the Society, with Lord Windsor's permission, to the Cardiff Museum, as a donation. Particulars of this collection are set forth in the following list :—

LIST OF ARTICLES FOUND.

Pre-Roman.

Lias slab, with natural cavity, and sandstone muller, found together.
Hammerstone, with marks of use well shown.
Flint, triangular arrow head, a good specimen, and perfect.
Flint, leaf-shaped arrow head, very fine, but point broken off and not found.
Flint, fragments (two), not shaped but well broken.
Tally Stone, marks not yet understood.
A considerable number of pieces of hand-made pottery, but no complete utensil.


210
230
220
240
COARSE
RED TILE TESSERÆ
PEBBLE CONCRETE
COIN
2 COINS
SAMIAN FRAGMENTS
LOOSE PITCHING
OUTSIDE THE WALL
MANGANESE
ORE
40
50 FEET

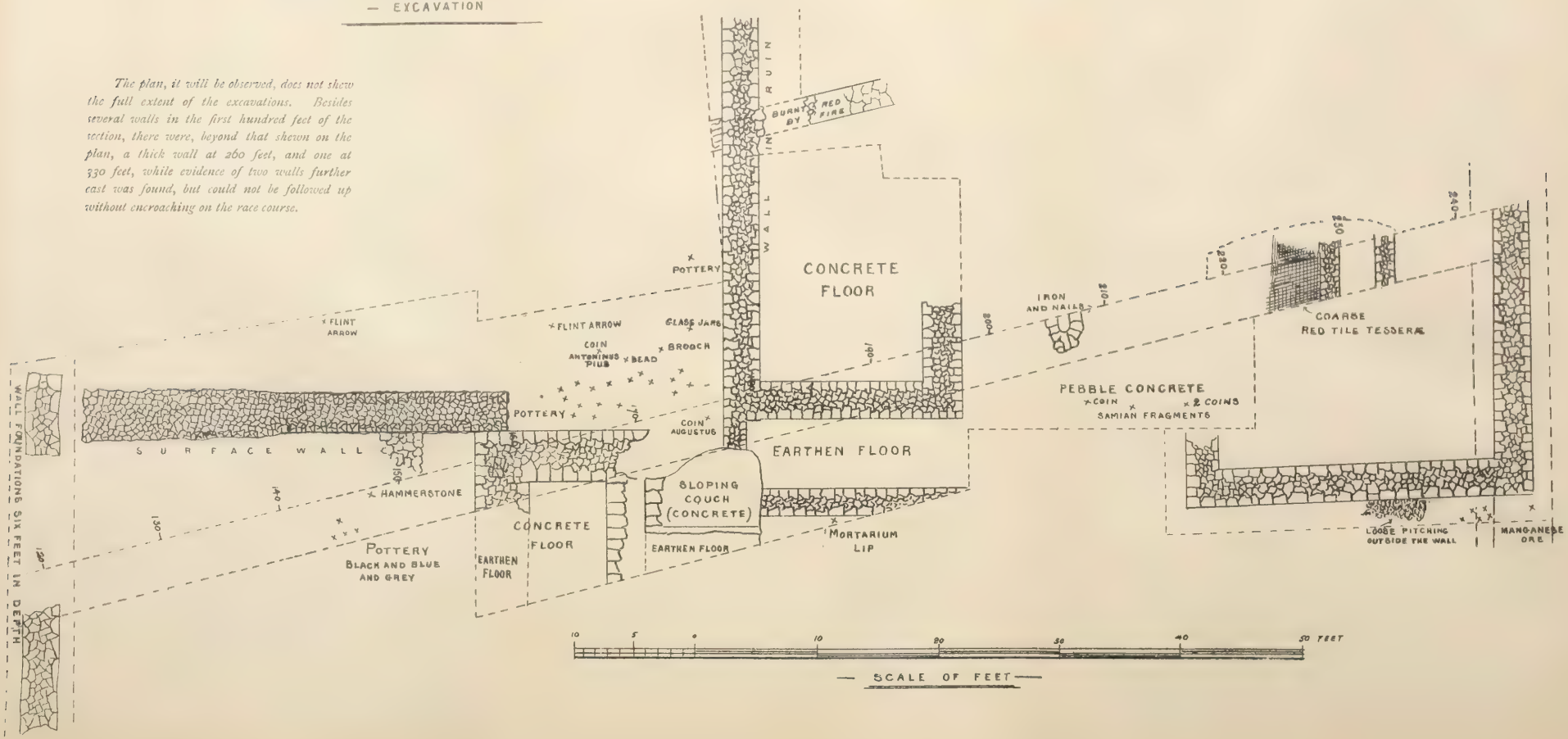
EXPLORATION OF THE Remains of a Roman Villa

ON THE RACECOURSE AT ELY NEAR CARDIFF

AS LAID DOWN BY Mr JOHN STORRIE.
AND RE-DRAWN BY Mr EDWIN SEWARD.

N.B. DOTTED LINES INDICATE LIMITS OF — EXCAVATION

The plan, it will be observed, does not show the full extent of the excavations. Besides several walls in the first hundred feet of the section, there were, beyond that shewn on the plan, a thick wall at 260 feet, and one at 330 feet, while evidence of two walls further east was found, but could not be followed up without encroaching on the race course.



Roman.

Silver denarius of Antoninus Pius, nearly in Mint condition.
Bronze Second Brass Nerva, fine patina reverse smooth.
Bronze Quadrans, consular coin of Augustus.
Bronze Coin, illegible, but certainly Roman.
Leaden Coin, illegible and unknown.
Medallion Brooch, bronze and enamel, bronze perfect, enamel much perished.
Fragment of twisted bronze armillæ.
Small bronze bar, about 2 inches long, hammered.
Bronze pin, with twisted end.
Bronze article—drop of ear-ring or handle of ear-pick.
Bronze, two fragments which had been melted.
Bronze, small tube 1½ inch long.
Lead, a shapeless fragment.
Iron, Roman horseshoe, a good example showing the inside bearing well.
Iron, part of a hinge.
Iron, door latch (part of).
Iron, large stay nail.
Four fragments of iron, uses unknown.
Small tool in horn handle (probably carving tool).
Large quantities of nails, from 2 to 6 inches in length, some nearly straight, but most bent and twisted as from action of fire.
Sharpening stone of Pennant sandstone, broken and much used.
Small sharpening stone of Pennant sandstone, with gouge slip.
Sharpening stone of old red sandstone, much worn and broken.
Pottery, one piece of Samian ware, with pendant and tassel ornament.
„ a number of small pieces of plain Samian ware.
„ two pieces of imitation Samian ware.
„ a number of fragments of ordinary red pottery.
„ grey ware spindle whorl.
„ nearly complete black smother-kiln ware jar, with diamond ornament.
„ fragments of two more or less complete black ware jars
„ many fragments of grey ware-vessels, one with waved pattern nearly complete.
„ many fragments of blue and brown ware jars.
„ small piece of white pottery with blue surface.
„ fragments of three, probably four, mortaria.
„ quantity of vitrified stones.
„ quantity of iron slag and clinker.
„ quantity of iron cinder.
„ about 2 cwt. of manganese ore (very rich)
„ quantity of coal from outcrop of coal seams.
„ two fragments of key bricks of hypocaust valve.
Three fragments of Querns.
Two stone slates, with nails remaining.

Several stone slates, more or less perfect.

A large number of pieces of wall plaster, richly coloured, some with designs, in Imperial red, Pompeiian red, green in several shades, blue in two shades, various shades of yellow, orange, and brown.

Pieces of Pennant roofing, stone still unsplit but still splittable, showing that it was brought in the rough and split and dressed on the spot.

Part of exceedingly thin human skull.

Quantities of bones of horse, cow, sheep, pig, and hare bones, but no complete skeleton.

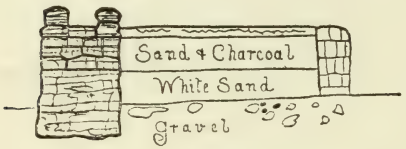
Roman Iron-Making at Ely Race-Course.

By JOHN STORRIE.

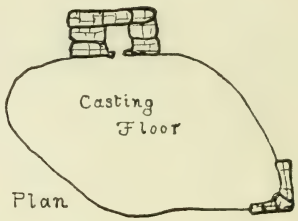
DURING the course of the excavations on the site of a Roman Villa on Ely Race-course, near Cardiff, I came into a patch of ground where slag, clinkers, and small fragments of cast-iron were brought to light; and careful working showed that a foundry hearth of a rather primitive character had been formed, and that it had been used for the production of iron. I had for several days before coming to this part of the trench found pieces of iron ore, one of which was of the encrinital character of the Rhubina ore, as exposed near Mr. Tellefsen's villa of Heimdāl, and the other sort as certainly agreeing in character with the ore from the disused mine near Wenvoe, a sort of hematite, not uncommon in the mountain limestone of the district, but varying in appearance according to the mine which produces it. The Rhubina Mine is about 5 miles, and the Wenvoe Mine about 1¼ miles distant as the crow flies, but, of course, rather further by the roads. Besides these two varieties of iron ores, I also picked up small pieces of manganese ore occasionally; but as I was more interested at that time in the development of the Roman Villa and plan of its walls, the furnace hearth was passed on one side and the trenches continued, but I called the attention of some members of the Naturalists' Society's Committee to it, and part of it was dug out.

The hearth was about nine inches in diameter, burnt to an irregular circle, but had probably been square originally. Only two courses of masonry remained, but any indication of blowing hole or tweer had perished, if such had ever existed. The walls had been razed down to the two last courses, and although the stones still remained, they were shifted from their original positions; and it is now impossible to say whether the furnace had boshes, or whether the same internal diameter was continued to the top. Both ends of the dam

stone still remained, but the middle was burnt and broken away. The material employed was wholly old red sandstone, but whence procured I am unable to state positively. The adjoining casting floor consisted of a layer of white sand about eight inches in thickness, which had been laid on the natural ground level (gravel drift), and on the top of this was a layer of sand and charcoal about twelve inches thick, covered with a thin layer of very fine clayey loam of about two inches in thickness, in which were the fragments of metal, slag, &c., which had been run.



Section



Plan

This floor or bank, therefore, formed a sort of platform elevated nearly two feet above the natural ground level, and had been at some time surrounded by a wall of rough character of ordinary lias limestone, which enclosed a space of about six feet by five.

Although a little charcoal was found during the excavations, ordinary coal seems to have been largely used, and some pieces I have preserved show the character of the bed from which it was taken. I would not hesitate to say that it was from the outcrop of one of the very lowest seams of the district, and very likely from near the spot where Pentyrch Ironworks now stand, because coal of exactly similar character occurs there.

That the Romans were adepts at the manufacture of iron has been always well known, but their process of working was not very clearly understood; and I think that, until a meeting of the Cardiff Naturalists' Society on November 22nd, 1883, when I read some notes on this subject in reference to some iron slag and cinder found by me under an unmoved Roman tessellated pavement at Caerwent, it was not known that in this district at least the Romans had used coal in iron smelting. The slag and cinder in question having been found in a place where all probability of its later origin was cut off, was clearly evidence, and when examined showed actual coal embedded in it. The cinder was analised at the Dowlais Works by an analyst well used to such work, and fully bore out its claim to be ancient and undoubted Roman cinder, probably from a *fabrica* or military forge established there before the building of the house which had this tessellated floor (see Volume XV., page 94, Cardiff Naturalists' Society's Transactions). The specimens are in the Free Museum, Cardiff.

Remembering what I had found at Caerwent five years before, in 1888, when working the Roman Villa I discovered near Llantwit Major, I kept a good look-out for signs of coal and signs of iron working, and soon came upon unmistakable coal, also from the outcrop, and almost certainly brought from Penprisk, where a coal of exactly the same physical characters is found, the identification being rendered more certain by the peculiar diamond-shaped form of the fragments of coal, which is the natural fracture of the Penprisk bed.

About three yards from the furnace was a little hillock of the afore-mentioned manganese ore, containing rather over 2 cwt. I had not at first taken much notice of the small pieces of manganese ore; but immediately on finding the larger quantity, I submitted it to Mr. Frank Johnson, F.G.S., Mining Inspector to the Tharsis Copper Mining Company, and several other friends, all of whom confirmed my opinion that it was not a British ore, Mr. Johnson stating that it was undoubtedly a Spanish ore, but of a quality not to be got readily nowadays.

Through the kindness of Mr. E. P. Martin, Managing Director of the Dowlais Ironworks, who takes a deep interest in the history of ancient iron-making, I am enabled to give the following exhaustive analysis of this ore :—

Dowlais Iron Works,
17/11/94.

[Copy of Laboratory Report.]

Manganese ore found by Mr. Storrie near a Roman Furnace west of the Roman Villa on Ely Race-course.

Three small lumps received on the 5th inst. are of the following analysis :—

Ore dried at 212° F.

Manganese peroxide	44·74 %
Manganese protoxide	32·42
Ferric oxide	1·71
Lead oxide	·05
Copper oxide	nil
Zinc oxide	nil
Alumina	·50
Baryta	3·75
Lime	1·50
Magnesia	·72
Silica	8·60
Sulphuric Acid (So3)	·055
Phosphoric Acid	·069
Arsenic	nil
Combined Water and Carbonic Acid ...	5·00
	99·114
Metallic manganese	53·40
Sulphur	·022
Phosphorus	·03

This is a manganese ore of a rich quality, and is similar to what is used in the manufacture of Ferro-manganese.

The amount of iron in this ore, as shown by the analysis, entirely precludes all idea of its being used as an iron ore, and if so, what else could it have been used for; and although the quantity (2 cwt.) is not large, it is more than would have been brought so far without some good reason; and its use in steeling their iron seems to me by far the most probable of any, more especially as their glass is certainly not decoloured by manganese, and there seems to be no other thing it could reasonably be thought fit for in the Roman economy, as the manufacture of chlorine, permanganate, or oxygen is extremely unlikely to have been attempted in Roman times.

At Ely, of course, I was particularly anxious to see if any confirmation or further information regarding iron working came to light, and hailed the finding of the manganese ore with satisfaction, and also the finding of two pieces of metal nearly shapeless, but which may have been parts of a knife or some such instrument; both of these pieces, when freed of earthly matter and rust, I had heated and beaten out, and found them able to be hardened and softened, showing them to be to all intents and purposes steel.

An examination of the glass and vitrified stones found at Ely shows that manganese was not used in its manufacture, and therefore it is probable that the Romans may have used the manganese ore in the manufacture of a kind of steel, which would be as easily made as iron, the difference between the two metals being one of decarbonization only.

The origin of the manganese ore was rather a puzzle, but as it was seen by so many persons well qualified to judge, and universally pronounced to be foreign, really the only matter to decide is, what was the object of bringing this ore from Spain to Ely; and no adequate motive can be assigned, except that it was found useful in the iron-making, and that, in fact, that they steeled their iron with it, whether by a process of decarbonization and recarbonizing with the aid of the manganese, or by direct fusion and decarbonization, there is at present no evidence to show, though the latter is most likely under the circumstances.

It is somewhat curious that although great quantities of Roman iron articles have been found both in this and other countries, no steel article, so far as I have been able to learn, has ever been found before; and the manufacture of steel is usually considered to have been an eighth century discovery, in the Erzberg district of Styria, where steel has certainly been manufactured since that period; but as the Erzberg mines were worked by the Romans during the first four centuries after Christ, it may not have been a real discovery, but a re-discovery or variation in method to the cementation of an older or ordinary process; but the finding of two pieces of steel, capable of being tempered, at Ely, shows that here at least, whether by accident or design, and owing to the finding of the Spanish manganese ore, most likely by design, actual steel was manufactured in the little furnace we are now describing.

It is certain that manganese was used in the manufacture of steel at Sheffield long before the era of either Mushet, Bessemer, or any of the modern steel makers, and that it played an important part in the process, although it was most strictly kept secret and in the hands of a few individuals only ; and it is quite possible that the secret may have come down even from the remote period when the *Roman fabrica* at Ely was working, as trade secrets were always very strictly guarded, and seldom allowed beyond the family circle of those interested.

Conversazione, 1st December, 1893.

UPON the proposal of the President (Mr. E. Seward) the Committee decided to hold a Conversazione during the Session 1893-4, and it took place upon Friday, 1st December, 1893, at the Town Hall. The use of the Assembly Rooms, Council Chamber, and Nisi Prius Court was kindly granted by the Right Worshipful the Mayor—W. J. Trounce, Esq.

The principal items in the evening's programme were :—

An Alpine Sketch, entitled: "A Day on the Jungfrau," by the Rev. Canon Thompson, D.D. (with lantern views).

A Lantern Exhibition of Micro-photographs, prepared by Mr. Andrew Van Pringle, F.R.M.S., and Dr. Van Huric, and shewn by Mr. Wm. Davis.

An Exhibition of Microscopes and Microscopical Appliances and Objects, under the superintendence of Dr. C. T. Vachell.

Demonstrations of high speed transmission of Telegrams, arranged by Mr. H. J. Vose, District Superintendent of Telegraphs.

There were also a large number of exhibits of artistic and antiquarian interest, including :—

Examples of Old Book Binding, Old English Byegones, Old Plate, &c., by the President—Mr. E. Seward.

Burmese Silver Bowl, and a large number of Specimens of Japanese and Chinese Workmanship, lent by Col. Sir Edward S. Hill, K.C.B., M.P., and Lady Hill.

Sketches shewing Natural History Features of the Flat Holm, Grass Holm, &c., by Mr. T. H. Thomas, R.C.A.

Photographs of Archæological Objects from the Counties of Carmarthen, Pembroke, and Cardigan, lent by Mr. J. Mansel Franklen.

And a Collection Illustrating Usages of Old English Life, lent by Mr. R. Drane, of which he gave the following interesting descriptions:—

1. *A set of 12 Dessert Trenchers of Elizabeth's reign.*

They are of beechwood; one side is plain and the other decorated and inscribed. Sweetmeats were eaten from the plain side, and then each guest had to turn up the trencher and read what was upon it. The fun consisted in its applicability or the reverse, and which doubtless was sometimes anything but fun. The odd mixture of religion and festivity is very curious and characteristic of the time.

Only a few sets of these trenchers are known to exist. There are several in the British Museum, but most of them are inferior to this. They are sometimes rectangular.

2. *A Voyder-Dish of Elizabeth's reign, hammered brass, inscribed four times—Begin agen Ave.*

Its use *before* meat is thus indicated—

"A voyder upon—the table then have
"The trenchers napkins—therein to receive."

During the meal it was used to "avoyd bones and famosities"; that is, the inedible or rejected parts of food, and after meat the same voyder dish was thus used.

"The croomes with a napkin—togeder them swepe
"It at the tables ende—in a voyder them kepe."

Very few examples of the voyder dish, so illustrative of the habits of the time, remain to us.

3. *A Shoehorn, of Elizabeth's reign, inscribed thus:—*

"This is Wylyam Rownyns shoein horne made by the handes of Robart Mindum anno domine 1594."

4. *A Belarmine of Elizabeth's reign.*

These were made to hold pints, quarts, and gallons. They were in general use as measures in taverns, then called "mughouses," and later "pothouses." They were called "mugs." They bore in front an ugly visage to represent in an offensive way the "hard faced" Cardinal Belarmine—the Roman controversialist and active opponent of the Protestants in the Low Countries. They gave the modern "mug" its synonym for "face." Thus, one person meeting another (both going for beer to a mughouse) would ask, "Where are you going with your ugly mug?" That is, "From what tavern do you get your beer?"

5. *A Pomander of Elizabeth's reign. German.*

These were used as receptacles for perfumes, opened when occasion required to emit their odours as necessary disinfectants or agreeable elegancies in the then existing conditions of society. Cardinal Wolsey used something of this kind to counteract the ill-odour of the people frequenting the courts in which he administered justice.

6. *Magical Cup of Unicorn's Horn. Temp. James I.*

It was supposed to possess the power of detecting poison in wine by causing such wine to efferverse and boil over, when put into it.

The unicorn has been described as "a mythical animal now extinct"—it is really the rhinoceros.

7. *Black Jack (silver-lined and mounted). Temp. James I.*

Black Jacks were in ordinary use as drinking vessels and measures. They varied in size from a pint to two gallons, and gave rise to the French Ambassador's description of the English as a "barbarous people," because "they drank their beer from old boots."

8. *A Knife and Fork in a needlework case, and a Knife in a leather sheath. Temp. James I.*

The *fork* was introduced into English use in the reign of James I., in the earlier years of which it was still the custom to eat with the fingers, the directions in the children's books of that time being, "Sette no more than two fingurs and a thombe in your dysshe at one time."

The knife and fork then represent the latest refinement of the time, and a "real lady," going out to dinner, would take such an equipage with her: but her husband would have thought the use of a *fork* foppish and effeminate, so he still conformed to the old usage, and took with him a knife only. The two contemporary and *en suite* are very rarely to be seen.

9. *Headman's Mask. Temp. Chas. I.*

Used at State executions to conceal the identity of the actor, and said to be one of those employed at the execution of the king.

10. *Sack Bottle. Temp. Charles I.*

In common use as wine bottles, some are marked "WHIT" for white wine, others "CLARET," &c.; this one is for the "Sec" wine of "Xeres," hence the words "Sherris Sack" or "dry Sherry," the "Sec" indicating that the wine was made from grapes partially *dried* in the sun before going to the wine-press.

11. *Silver-hilted Rapier. Temp. Charles I.*

Inscribed: "L'amour et le monde sont deu Cazalles. L'un trouble le Cœur et la otre les entrailles."

12. *Knife and Fork in leather sheath. Temp. Charles II.*

It is interesting to compare these with those of the reign of James I., and so note the change of habit which fifty years had effected. These are for a gentleman who has now learned to use the fork, which is no longer the finnicking thing it was when first introduced.

13. *Brank.—Scold's Bridle.*

Vevy commonly, but never legally, used as an instrument of punishment for brawling women (and occasionally men), down to the end of the first quarter of this century, 1824.

No two branks are exactly alike.—Some are savagely designed to cause the maximum of pain—others, like this one, are simple and do not inflict great suffering. This particular brank is probably of the reign of William III., and is figured in Andrews' "Punishments of the Olden Time," page 40. It is not known to what town or parish it belonged.

14. *A Circular Dish of Lambeth Fayence with a very rude portrait of William III.*

These dishes were popular and common at the end of the 17th century, and were used each year on the 29th of January for serving up calf's head, in grim commemoration of the decapitation of Charles I.

15. *A "Horn Book," or Child's First Book,*

By which it was taught its alphabet and first spelling lessons. It is of the early part of the last century. Examples are now very scarce and this may be considered only a moderately good one. It is genuine, but late; those of 17th century are rather larger, and some of them highly finished.

16. *A Lambeth Ware Dessert of Six Plates, inscribed:—*

1. What is a merrey man ?
2. Let him doe what he cane
3. To entertaine his guests
4. With wine and merrey iests ;
5. But if his wife doth frowne
6. All merriment goes downe.

They were made by immigrant Dutch potters in the latter part of the 17th century, and were very popular till the middle of the 18th. The early ones are octagonal, the late circular, of which one is shewn for comparison dated 1734.

17. *A Snuff Box. French. Tortoise-shell and gold; having in its cover a contemporary portrait of the Young Pretender.*

Souvenirs of the Stuarts were as popular amongst their adherents as dishes, such as the above, were with their opponents even down to the middle of the last century.

18. *Sandbox, chased and inscribed "John Oat's, Sheffield, 1742."*

Used for drying writing before blotting-paper came in.

19. *Smuggler's Flash, by which signals were given by a noiseless flash of light.*

It was found a few years ago in a farm house on the north coast of Devon, where it had remained since its use in the good old times.

During the evening a programme of music was performed by Mr. Fred G. Roberts' Band.

Refreshments were served during the evening in the Ante-Assembly Room.

Mr. Ronald A. Scott, M.R.I., M.I.E.E., had made arrangements to exhibit his patent appliance for throwing images of letters and characters on the clouds by means of an electric search light and other experiments, but owing to unforeseen circumstances was unable to carry them into effect.

Below is appended a balance sheet showing how the expenses of the Conversazione were defrayed.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Printing accounts	17	17	6	By Contribution towards expenses from funds of the Society	37	2	6
,, Refreshments	20	9	3	,, Contribution of the President (Mr. E. Seward) ...	25	0	0
,, Decorations and chairs ...	3	3	0	,, Balance contributed by a member of the Committee	0	12	6
,, Music	5	0	0				
,, Gas and cleaning	2	7	0				
,, Expenses of portico, tables, screens, etc.	4	12	6				
,, Petty expenses, including postages, conveyances, gratuities, etc.	9	5	9				
	£62	15	0		£62	15	0

Biological and Geological Section.

COMMITTEE:

The PRESIDENT and HON. SECRETARY of the C.N.S. *(ex-officio).*

President—T. H. THOMAS, R.C.A.

Vice-President—C. T. VACHELL, M.D.

F. T. HOWARD, B.A., W. W. PETTIGREW, J. STORRIE, and W. N. PARKER, PH.D. (Hon. Secretary).

THE following meetings have been held during the Session:—
Ordinary Meetings, 6. Average attendance, 19·8.

FIELD MEETINGS.

1.—To the Steep Holm, on May 29th, in the steam tug "Nelson," kindly placed at the disposal of the section by Edmund Handcock, Esq., jun. Attendance 20.

The number of members at present on the books is 50, and the Committee are glad to report that the interest shown in the meetings and the amount of work done has increased.

The accounts show a balance in hand of £9 17s. 10d.

The following papers have been read during the session:—

1893.

Nov. 9th.—R. DRANE, F.L.S.—"Natural History Notes from Grassholm" (illustrated by lantern slides by Mr. Storrie, and sketches by the President).*

Dec. 7th.—E. HAWKE DAWE.—"Recent methods of preparing and staining vegetable sections for the microscope."

„ 7th.—T. W. PROGER.—Remarks on the following specimens which had recently been obtained in this neighbourhood:—

1.—Cinnamon coloured variety of the Woodcock. (*Scolopux insticoler*).

2.—Rotche, or Little Auk. (*Aria minor*).

3.—Polecat. (*Musteles putorius*).

4.—A specimen which it was not possible to determine with certainty, and which was possibly either an old Pole cat or a Fitchew ferret.

1894.

Jan. 18th.—F. T. HOWARD, B.A.—"The theories of the formation of the hæmatite deposits of South Wales."*

„ 18th.—C. T. VACHELL, M.D.—"Note on a doubtful species of *Senecio*."*

Feb. 22nd.—T. H. THOMAS, R.C.A.—"Methods of illustration for scientific works."*

„ 22nd.—J. STORRIE.—Exhibition of various sections of plant and animal tissues with the lantern.

April 12th.—F. W. WOTTON, M.C.S. (Communicated and read by J. J. Neale)—"Notes on the nest of *Lima*."*

„ 12th.—W. W. PETTIGREW.—"Remarks upon a reverted form of the geranium 'Mrs. Pollock.'"

„ 12th.—R. RHYS GRIFFITHS, M.B.—"Notes on pathological and other specimens."

„ 12th.—W. N. PARKER, PH.D.—"On Semon's recent researches on the habits and embryology of Ceratodus."

May 17th.—J. STORRIE.—"Notes on the occurrence of Mastodonsaurus at Penarth,"* and "On the occurrence of native gold in the New Red Marl series at Cardiff."*

„ 17th.—A. H. TROW, B.Sc.—"Notes on preparation of bi-sexual flowers of *Pinus sylvestris*,"* and "On apogamous prothallia of *Pteris serrulata* (var. *cristata*)."

In addition to the specimens shown in connection with the above papers, the following were also exhibited:—

Six-toed Cat (F. T. Howard); Variety of Primrose (R. Drane); Collection of New Zealand Ferns (W. N. Parker); Abnormal Flowers of *Narcissus biflorus* (A. H. Trow), &c.

W. N. PARKER,

June 12th, 1894. *Hon. Secretary.*

* The papers marked with an asterisk will be found *in extenso* or in extract in the Society's Transactions.

Report of Committee for 1893-4.

THE Committee have the pleasure of presenting to the members of this Society their Twenty-seventh Annual Report. The number of members on the Society's books at the close of the session was:—

Number of members, 1st October, 1893		390
Elected during 1893-4		91
		481
Deaths		5
Resignations and removals		24
		29
Number of Members 1st October, 1894		452

They are thus distributed:—

Honorary Members...	8
Life Members	19
Annual Subscribers	425
	452

The Committe regret the loss by death of Miss Grover, Messrs. James Colquhoun, Horatio Hooper, and J. Tomlinson, and the Rev. Thos. Jenkins.

The balance sheet shows a balance of £166 10s. 10d. carried forward into the new year.

The following is a list of Papers read before the Society :—

Oct. 26th, 1893.	Annual Meeting. Inaugural Address by the new President, Mr. Edwin Seward, F.R.I.B.A.
Jan. 11th, 1894.	Mr. R. W. Atkinson, B.Sc., "Glimpses of the Life and Lore Legand of Old Japan," with Lantern illustrations.
Feb. 8th „	Mr. Ivor James, "An Account of a Visit to examine certain groups of ancient circular shallow excavations on the mountains of Monmouth and Brecon."
March 8th, 1894.	Dr. P. Rhys Griffiths, "The Weather Proverbs of Wales;" a comparison with similar proverbs of other countries.
March „ „	Rev. G. Hartwell Jones, "Picture Writing," with Lantern illustrations.
April 5th, „	Dr. C. T. Vachell, "Local Daffodils and Narcissi," with Lantern illustrations.
April 19th, „	Professor Evan W. Small, M.A., "Why is the Sea Salt?" A study in the history of natural waters, with Lantern illustrations and experiments.

The following Public Lectures were delivered :—

Nov. 2nd, 1893.	Professor J. A. Ewing, F.R.S., "Molecular Magnetism," with experiments and Lantern illustrations.
Dec. 14th, „	Dr. Andrew Wilson, F.R.S.E., F.L.S., "The Transformation of Animals, and what they teach us," with Lantern illustrations.
Jan. 25th, 1894.	Dr. H. Woodward, "Our Pre-historic Ancestors in Europe," with Lantern illustrations.
Feb. 15th, „	Professor Silvanus Thompson, F.R.S., "The Magic Mirrors of Japan," with Lantern illustrations.
March 15th, 1894.	Professor A. C. Haddon, "Fairy Tales," with Lantern illustrations.

On 8th March, 1894, Principal J. V. Jones presented his report as the Society's delegate at the meeting of the Corresponding Societies Committee of the British Association at the Nottingham Meeting, 1893.

On December 1st, a Conversazione was held at the Town Hall, of which a short account with a balance sheet will be given in the Transactions.

The thanks of the Society are due to the members who have read papers; and also to those ladies and gentlemen who entertained the lecturers. During the past session the lectures and meetings have been held in the Queen-street Public Hall, with the exception of the first two, one of which was held (by kind permission of His Worship the Mayor) in the Assembly Room, and the second in the Lesser Park Hall.

The first Field Meeting was held at the Melin-Griffith Tin Plate Works, on the 2nd May, by kind invitation of the Directors of the Melin-Griffith Company, Limited. The members, after inspecting the works, were entertained at tea at the "Lewis Arms," Tongwynlais, by the Directors, to whom a hearty vote of thanks was accorded.

The Annual Field Meeting (Ladies' Day) was held in the "Golden Valley" on the 27th June, about eighty ladies and gentlemen being present. The members proceeded from Cardiff by the G.W.R. to Pontrilas, and thence to Hay by the "Golden Valley" line—the latter part of the journey being made by special train of the "Golden Valley" Railway Company, through the courtesy of E. L. Gavin Robinson, Esq., the Hon. Director. The President of the Woolhope Naturalists' Field Club (Mr. James Davies), with Mrs. Davies, the Hon. Sec. (Dr. H. C. Moore), and several other members of the Club joined the Society by invitation at Pontrilas and at Hay.

After luncheon at the "Crown" Hotel, the party returned down the Valley by the "Special," and stoppages were made first at Peterchurch, where the church was inspected under the kind guidance of the Vicar, the Rev. W. F. A. Lambert, who read a short paper upon the building, and secondly at Vowchurch, where the Rev. J. O. Bevan, Vicar, conducted the members through the church, and also read a descriptive paper.

The next halt was made at Abbeydore, where, after inspecting a short section of Roman road specially uncovered, the grand remains of the Abbey were visited under the leadership of the Vicar, the Rev. A. Phillips, who afterwards read a most interesting paper descriptive of the sacred edifice.

Tea was served at Pontrilas Inn, and before entraining for home the members were enabled, by the courtesy of Mr. and Mrs. Attwood Matthews, to inspect the house and grounds of Pontrilas Court. The warmest thanks of the Society are due to the rev. gentlemen who so greatly added to the pleasure of the day.

The third Field Meeting was held on the 28th August, at Caerleon, in conjunction with the members of the Woolhope Field Club, where the contents of the Museum and Roman remains were inspected under the experienced guidance of F. J. Mitchell, Esq., of Llanfrechfa Grange. Tea was taken at the Hanbury Arms, where was seen the chair used by Tennyson whilst staying here, before his "Idylls of the King" was published. The Committee hope that this meeting may be the fore-runner of other joint meetings with our neighbours, the Woolhope Field Club.

On the 26th June, the members of the Woolhope Field Club visited Cardiff, and was conducted over Cardiff Castle by our President, Mr. Edwin Seward. Llandaff Cathedral was afterwards visited, and subsequently the party proceeded to Penarth, accompanied by Mr. John Storrie, who pointed out the geological features of interest in that neighbourhood.

The past year has been marked by an important departure in the formation of an Archæological Section of the Society, somewhat on the lines of the previously existing Biological and Geological Section.

Of the new section, the Rev. Canon Thompson has accepted the Presidency, and Mr. Edwin Seward (under whose auspices as President of the Society the section was formed) the Hon. Secretaryship; and a membership of 55 has already been attained. It is confidently hoped that this section of the Society will accomplish important work in our district, where there is so much to be done.

In the month of May last, Mr. John Storrie discovered on the Ely Race Course, certain mounds, under which he believed were pre-historic or Roman remains. Upon communicating his opinion to the Committee, it was determined to take the matter up; and necessary permission having been obtained from the owner of the land (the Right Hon. Lord Windsor) and the tenant (Mr. R. Emerson), trial excavations were commenced under Mr. Storrie's superintendence, and these were continued during the summer with the most gratifying results. It was found that the principal mound contained the remains of a large and important Roman villa, where have been found a large number of articles of Roman, and some of pre-historic, origin. These, with the permission of Lord Windsor, have been handed to the Cardiff Museum Committee.

The cost of the proceedings has been considerable, and has been defrayed partly by a grant of £25 made by the Committee from the funds of the Society, and partly by subscriptions of members and others, as per list herewith. Owing to lack of funds the work has now been stopped, and unless further pecuniary assistance is forthcoming, the Committee will close in the excavations after making careful plans of the remains explored. The matter is now receiving the attention of the Committee, and an effort is being made to obtain further funds to carry on the work. When it has been completed, or, if necessary, abandoned, a full report will be duly made to the Society, and a balance sheet presented.

It was with much gratification that the Committee learned that in August last the Royal Assent had been given to the Wild Birds' Protection Act, 1894, which may be said to be the outcome of action taken by the Society. Up to the passing of this Act, although certain wild birds were themselves afforded protection during a specified close-time, there existed no provision for preventing the extermination of rare and interesting species by taking or destroying their eggs.

It will be within the recollection of the members that in autumn, 1890, Mr. Thomas H. Thomas, Vice-President of the Society, accompanied by a small party of our members, paid a visit of inspection to the gannet settlement on the island of Grassholm, at the mouth of the Bristol Channel. While there they were eye-witnesses of a wholesale and wanton destruction of the sea birds' eggs by a number of gentlemen who landed from a steamer. The matter having been considered by the Committee, was brought before the British Association for the

Advancement of Science, at their meeting in Cardiff, in 1891. In response to those representations, the Association appointed a committee consisting of several well-known ornithologists, together with the following members of the Society—viz.: Mr. Thomas H. Thomas and Professor Newton Parker (Dr. C. T. Vachell being appointed Honorary Secretary), to consider proposals for the legislative protection of wild birds' eggs.

The subject was not entirely new, for it had been under the consideration of the Association some years before, but chiefly then in connection with bird's-nesting; and the conclusion then come to was that ordinary bird's-nesting had no appreciable effect in diminishing the numbers of wild birds. It was, however, now shown that unless a check were made on the organized depredations of dealers in wild birds' eggs, it would become impossible for certain species, such as the great skua, to breed in Great Britain, and it was determined to endeavour to secure protection for eggs. It is well known that the rarest of our wild birds breed year after year in the same restricted spots and areas. Accordingly a Bill was introduced in February, 1891, by Mr. Alfred Pease, proposing to permit County Councils to prohibit the taking or destroying of wild birds' eggs within defined areas; but as Parliament was very soon dissolved the Bill fell through.

Mr. Alfred Pease was not elected in the next Parliament, and Sir Herbert Maxwell was induced by the British Association Committee to take charge of the Bill. This Bill was brought into the House of Commons on April 13th, 1893, but it differed entirely from Mr. Pease's Bill in that it sought to protect the eggs of certain species of wild birds, and omitted all references to the plan of protecting defined areas, or "sanctuaries" as they are termed in Australia. The Bill rapidly passed through the House of Commons, but was considerably amended in the House of Lords, mainly owing to the representations of the British Association Committee, who favoured the principle of Mr. Pease's Bill, considering that in consequence of the great difficulty experienced in identifying the eggs of many species of wild birds, the Act would prove useless for the purpose of conviction. The House of Commons declined to accept the Lords' Amendments, and the Bill was lost.

The promoters of legislation for protecting eggs were thus seen to be seriously at variance as to the best method of giving effect to their wishes, and there seemed to be no possibility of reconciling them until it was suggested that the principles advocated by each party should be combined in a new Bill. This was done, and in April, 1894, the Bill was introduced. It provides (1) for the prohibition of taking eggs within specified areas, and (2) for the prohibition of taking eggs of named species of birds. With very slight amendment this Act has become law, and it is now within the power of a Secretary of State, upon the application of a County Council, by order to prohibit the taking or destroying the eggs of wild birds.

To the Officers of the Society the Committee are much indebted for the services rendered by them during the year in their respective offices.

Since the last Report of the Committee two parts of the Transactions have been issued—viz. : Part 2 of Vol. XXV., and Part 1 of Vol. XXVI. The former contains a map of the Society's District, and some beautiful illustrations of archæological remains in the neighbourhood of Bridgend, the cost of which has been generously defrayed by Mr. William Riley. The latter volume contains a number of illustrations of points of interest on the island of Grassholm, kindly provided at the cost of Mr. Robert Drane.

LIST OF SUBSCRIPTIONS TO ELY EXCAVATION FUND.

	£	s.	d.
The Right Honourable Lord Windsor	10	0	0
Mrs. Vaughan	10	0	0
Mr. W. Riley	6	5	0
The Right Honourable Lord Tredegar	5	0	0
Mr. R. Drane	2	2	0
,, T. M. Franklen	2	2	0
Sir E. S. Hill, K.C.B., M.P.	2	2	0
Mr. E. Seward	2	2	0
Dr. C. T. Vachell	2	2	0
Mr. J. Lynn Thomas	2	2	0
,, R. W. Atkinson	1	1	0
,, Geo. Arduser	1	1	0
,, R. P. Culley	1	1	0
Dr. F. Evans	1	1	0
Mr. C. H. James	1	1	0
,, O. H. Jones	1	1	0
,, J. Jenkins	1	1	0
,, J. H. Lucas	1	1	0
,, J. J. Neale	1	1	0
Mrs. S. W. Richards	1	1	0
Mr. J. Strachan	1	1	0
Colonel J. P. Turbervill	1	1	0
Rev. Canon Thompson	1	1	0
Mr. H. J. Vose	1	1	0
,, J. W. Vachell	1	1	0
,, T. J. Williams	1	1	0
,, C. T. Whitmell	1	1	0
Mrs. E. David	1	0	0
Mr. W. D. Huxtable	1	0	0
,, W. Rönnfeldt	1	0	0
,, T. Ambrose	0	10	6
,, — Bland	0	10	6
,, T. Bazely	0	10	6
,, G. Hopkins	0	10	6
,, E. Jenks	0	10	6
,, C. Knox	0	10	6
,, Dl. Lewis	0	10	6
,, S. W. Richards	0	10	6
,, J. S. Shepton	0	10	6
,, C. R. Waldron	0	10	6
,, A. Pettigrew	0	10	0
,, J. C. Cownie	0	5	0
	£70	14	0

List of Exchanges received from October 1st, 1893, to September 30th, 1894.

Bath Natural History Society; Proceedings, Vol. VIII., part 1.
Belfast Naturalists' Field Club; Annual Report and Proceedings, Vol. III., part 6; Vol. IV., part 1.
Belfast Natural History Society; Report and Proceedings for 1892-93.
Berwickshire Naturalists' Club; History, Vol. XIV., 1892.
British Association; Report, 1893. Nottingham Meeting.
Chester Society of Natural Science; 23rd Annual Report, 1893-94.
Dublin Royal Society; Transactions, Vol. IV., part 4; Vol. V., parts 1-4.
Dublin Royal Society; Proceedings, Vol. VII., part 5; Vol. VIII., parts 1 and 2.
Ealing Microscopical Society; Report and Proceedings for 1893.
East Kent Natural History Society; 34th, 35th and 36th Annual Reports.
Essex Naturalist; Vol. VII., parts 6-12.
Glasgow Philosophical Society; Proceedings, Vol. XXIV.
Hampshire Field Club; Proceedings, Vol. II., parts 2 and 3.
Hertfordshire Natural History Society; Vol. VII., parts 5 to 9.
Leicester Literary and Philosophical Society; Vol. III., parts 3 to 6.
Leopoldina; Hefts 28 and 29.
Liverpool Geological Association; Vol. XIII., 1892-1893.
Manchester Field Naturalists' Society; Report and Proceedings for 1893.
Manchester Geographical Society; Vol. VIII., Nos. 7-12; Vol. IX., Nos. 1-12; Vol. X., 1-3.
Manchester Geological Society; Transactions, Vol. XXII., parts 12 to 21.
Marlborough College Natural History Society; Report, No. 42, 1893.
Missouri Botanical Garden, U.S.A.; 5th Annual Report, 1894.
New South Wales Geological Society; Records, Vol. III., part 4; Vol. IV., part 1.
Northamptonshire Natural History Society; Journal, Nos. 53.56.
Nova Scotian Institute of Science; Vol. I. (new series), part 2, 1891-92.
Official Year Book of Science; 1893.
Philadelphia Academy of Natural Science, U.S.A.; parts 2-3, 1893; part 1, 1894.
Royal Miscroscopical Society; parts 5 and 6, 1893; parts 1-4, 1894.
Toscaña, Atti della Societa, Pisa; Vol. VIII., July; Vol. IX., January, March, May, 1894.
United States Geological Survey; Annual Report, No. 11, 2 vols., 1889-90,
United States National Museum; Bulletins, Nos. 43-46.
United States National Museum; Report, 1891; Proceedings, Vol. XV., 1892.

United States Smithsonian Institution ; Report for 1891.
Wisconsin Academy of Sciences, Arts, and Letters ; Vol. IX., parts 1 and 2.
Woolhope Club ; Transactions, 1890-92.
Royal Cornwall Polytechnic Society ; Annual Report, No. 61.
North Staffordshire Naturalists' Field Club ; Report and Transactions, Nos. 26 and 28.
Rochdale Literary and Scientific Society ; Transactions, Vol. I., II., III.
Rochdale Literary and Scientific Society ; 15th Annual Report, 1893.

Transactions have been received from only 37 Societies on our list, 20 Societies not having exchanged since the last Report. Two Societies have been added to the list, viz. : North Staffordshire Naturalists' Field Club, and the Rochdale Literary and Scientific Society.

A complete list of exchanges received from October 1st, 1893, to September 30th, 1894, is herewith given.

R. W. ATKINSON,

Hon. Librarian.

CARDIFF NATURALISTS' SOCIETY.

Balance Sheet for the Year ending 30th September, 1894.

Liabilities.	£	s.	d.
To Sundry Creditors	101	19	0
,, Conversazione Reserve Fund	10	13	0
,, Balance, being excess of Assets over Liabilities ...	166	10	10
	£279	2	10

Assets.		£	s.	d.
By Value of Furniture		8	0	0
,, ,, Library		7	19	0
,, Investments, viz. :—				
£90 Barry Preference Stock	£127 10 7			
Cardiff Building Society	53 11 5			
		181	2	0
,, Cash in Lloyds Bank		43	17	2
,, ,, in Treasurer's hand		0	10	6
,, Subscriptions in arrear		3	14	6
,, Value of Reports unsold		10	0	0
,, ,, Cardiff Flora unsold		3	17	6
,, Sundry Debtors		20	2	2
		£279	2	10

Dr. Revenue Account for the Year ending 30th September, 1894. *Cr.*

To		£	s.	d.		By		£	s.	d.
	Reports and Transactions—						Balance from last year's account	160	18	2
	Cost of Printing and Distributing ... £45 1 10					,,	Subscriptions	254	9	6
	Less Copies sold 2 9 6					,,	Life Member's Subscription	5	5	0
		42	12	4		,,	Interest on Investments	5	18	7
,,	Expenses of Field Meetings ... 58 17 1									
	Less Amount received for Tickets sold 49 3 4									
		9	13	9						
,,	Public Lectures... ... ... 94 6 4									
	Less taken at the Doors 4 9 0									
		89	17	4						
,,	Monthly Meetings	27	17	9						
,,	Stationery, Printing, and Postages	15	13	5						
,,	General Expenses, including Collector's Commission	33	4	9						
,,	Incidental Expenses	3	8	1						
,,	Amount reserved for Conversazione	10	13	0						
,,	Grant for Exploration at Ely	25	0	0						
,,	Written off for Depreciation of Library ...	1	0	0						
,,	,, ,, Furniture ...	1	0	0						
,,	Balance to be carried to next year's account ...	166	10	10						
		£426	11	3				£426	11	3

W. RÖNNFELDT,
Hon. Treasurer.
CARDIFF, 17th October, 1894.

WENTWORTH H. PRICE,
Chartered Accountant, *Auditor.*
CARDIFF, 21st December, 1894.

CARDIFF NATURALISTS' SOCIETY,

ESTABLISHED 1867.

Past-Presidents:

1868—WILLIAM ADAMS, C.E., F.G.S.
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1873—WILLIAM ADAMS, C.E., F.G.S.
1874—FRANKLEN G. EVANS, F.R.A.S., F.M.S.
1875—JOHN WALTER LUKIS, M.R.I.A.
1876—WILLIAM TAYLOR, M.D., &c.
1877—JOHN WALTER LUKIS, M.R.I.A.
1878—COLONEL PICTON TURBERVILL
1879—HENRY HEYWOOD, C.E., F.C.S.
1880—LOUIS TYLOR
1881—CLEMENT WALDRON
1882—GEORGE E. ROBINSON
1883—WILLIAM GALLOWAY
1884—PETER PRICE
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1888—T. H. THOMAS, R.C.A.
1889—W. RÖNNFELDT
1890—J. GAVEY
1891—C. T. VACHELL, M.D.
1892—C. T. VACHELL, M.D.

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F. W. WOTTON.

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President:

T. H. THOMAS, R.C.A.

Hon. Secretary:

Prof. W. N. PARKER, Ph.D., F.Z.S.

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1889—W. RÖNNFELDT
1890—J. GAVEY
1891—C. T. VACHELL, M.D.
1892—C. T. VACHELL, M.D.
1893—C. T. WHITMELL, M.A.

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EDWIN SEWARD, F.R.I.B.A.

Vice-Presidents:

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WILLIAM GALLOWAY.
H. HEYWOOD, J.P.
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A. PETTIGREW.
W. RILEY.
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J. T. THOMPSON, M.B.
W. J. TROUNCE.
A. H. TROW.

BIOLOGICAL AND GEOLOGICAL SECTION.

President:

T. H. THOMAS, R.C.A.

Hon. Secretary:

Prof. W. N. PARKER, Ph.D., F.Z.S.

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The President of the Bristol Naturalists' Society.
The Honorary Secretary of the Bristol Naturalists' Society.
The Honorary Librarian of the Brighton and Sussex Natural History Society.
Professor W. J. Sollas, Dublin.
The President of the Woolhope Club, Hereford.
The Honorary Secretary of the Woolhope Club, Hereford.
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By R. W. ATKINSON, B.Sc., Fellow of the Institute of Chemistry.

Delivered October 25th, 1894.

IT is my pleasing privilege, in the first place, to thank you for the honour you have done me in inviting me to assume for the coming year the duties of presiding over the work carried on by this important Society. Its aims and functions are manysided, but the essence of its activity lies in its object of keeping up in the town sympathy with the progress of scientific research. For, though we call ourselves the Cardiff Naturalists' Society, the application of the descriptive term is used in a very extended sense. Whether we look at the subjects of the popular lectures delivered before us by eminent scientific men, or at the papers read before the Society by its members, we see that their range is almost as wide as thought itself, and it is this breadth of view which, I believe, has maintained the vitality of the Society for so many years, in spite of the disadvantage under which it labours of having no permanent home. The absence to so large an extent of the social features, which many other societies possess, is perhaps the reason why the membership of the Society has not grown in proportion with the rapid increase in the population of our town. It does not seem altogether satisfactory to have to record that whilst within the last twenty years (1875-95) the population of Cardiff has more than doubled, and the rateable value of the town has increased nearly fourfold, the membership of the Society is now almost precisely the same as it was in 1875.* And this in spite of the great extension of scientific education, and the establishment of the University College in our midst, towards the attainment of which end our Society undoubtedly helped in a marked degree.

* Population—1875, 67,000; 1895, 150,000. Rateable value—1875, Quarter of a million; 1895, One million. Members—1875, 483; 1895, 452.

I do not wish to strike a pessimistic note at the commencement of this address; but I think we ought to look the facts fully in the face, and consider if we cannot arrive at a solution of the problem. At the same time, our membership is not by any means a contemptible one; there are, I believe, only one or two other societies in the United Kingdom with a larger number of members, still the fact remains that we have not increased in numbers in twenty years, and have therefore failed to some extent in our mission of interesting the general public in our studies. And when we learn that a small German town like Eisenach, with 24,000 inhabitants, can have a Naturalists' Society with as large a membership as our own, it does seem like a reproach to this, in other respects enterprising capital, that greater advantage should not be taken of the opportunities offered by this Society.

In the early years of the existence of the Cardiff Naturalists' Society, it was the custom of the retiring President to deliver the annual address, and this gave him the occasion to review the work of the session. Under present circumstances your President cannot do this, and indeed, practically, all that could be said is contained in the Annual Report. There are, however, one or two points upon which it may be of interest to enlarge somewhat; and, first of all, to one matter which recurred frequently in the earlier Presidential addresses,—the establishment of a Museum in connection with the Free Library.

As you all know, this connection lasted a great many years, with results not altogether satisfactory, for the Museum could only receive a small portion of the income produced by the 1d. rate, and this was little more than sufficient to pay the Curator, keep the Museum clean, with a trifle left over to purchase specimens. I need also hardly say that its position at the top of a lofty building, with a roof about which there were perennial complaints, was not calculated to attract visitors, nor, worst of all, could it attract gifts of pictures and other objects from those willing to contribute them. Better days are, however, in store for the Museum; the enlightened policy of the County Borough Council has given to the New Museum Committee, on which I am glad to say our Society is very largely represented, a ½d. rate of its own, and by the kindness of our Honorary Member, the Marquis of Bute, a piece of land in a central situation has been set apart for the Museum, and the conveyance of the land for Museum purposes already signed. It now only remains for the Committee to obtain powers to borrow money, and a Local Government Board enquiry will shortly be held for this purpose, to be able to build a Museum and Art Gallery which I am sure will be worthy of the reception of the artistic treasures and scientific valuables belonging, or promised to the town. This brief sketch of the history of the Museum will serve to show the value of such a Society as ours in questions bearing on Municipal scientific subjects, for who can doubt that without the energetic advocacy of several members of our Society, amongst whom, without prejudice to others, I may especially mention our esteemed Past Presidents—

Dr. C. T. Vachell and Mr. T. H. Thomas—the adoption of the Museums' Act would have been much delayed.

It is not, however, only in local matters that this Society has justified its existence. In July last a Bill for the Protection of Wild Birds received the Royal assent, in the initiation and prosecution of which the Cardiff Naturalists' Society did yeoman service. In consequence of the representations of this Society a committee of the British Association was appointed, including, together with well-known ornithologists, the following members of this Society:—Mr. T. H. Thomas, Prof. Wm. Parker, and Dr. Vachell as secretary, to consider proposals for the legislative protection of wild birds' eggs. The Bill as passed was a compromise, and provides (1) for the prohibition of taking eggs within specified areas, and (2) for the prohibition of taking the eggs of named species of birds. This has now become law, and it rests with the County Councils, on application to the Secretary of State, to obtain an order prohibiting the taking or destroying the eggs of wild birds within their districts. No doubt this Society will have to consider what steps must be taken to bring the matter before the County Council of Glamorgan, with a view of making the Act effective.

My remarks upon the work of the Society would not be complete without some reference to our Sections. The Biological Section has enlarged the scope of its work, and its name, by taking under its wing the study of local geology. And during the past year the Annual Report records the formation of an Archæological Section, which with Canon Thompson as president, and Mr. Seward as secretary, and a strong committee, may be expected to unearth unknown archæological treasures in the enlarged district of the Society. The archæological survey of Glamorganshire goes on slowly but surely, and the British Association Committee will no doubt co-operate with the newly-formed Archæological Section in continuing this work.

This is, I believe, the first occasion since Mr. H. Heywood occupied the presidential chair, in 1886, that a professed chemist has been in the position to deliver an address, and I may, perhaps, be excused if I desire to "improve the occasion" by giving some account of one or two more recent views as to the manner in which matter is constituted. For, to the chemist, the structure of matter is everything; the only object of the scientific chemist is to elucidate the construction of the bodies he has to deal with, and to investigate the laws under which combination of elements takes place. From a material point of view the application of this knowledge to the wants of every-day life is all important, and the general public looks upon this as the aim and end of the study of science. But before the chemist is in a position to make such application to industrial purposes of the knowledge gained by theoretical researches, these investigations must in the first place have been carried out by men devoted to the pursuit of science for its own sake. Everyone knows the enormous practical develop ment of the researches of Faraday on electrical phenomena, but who,

at the time they were being carried out, could have predicted the influence they would have upon the progress of arts and commerce in this century.

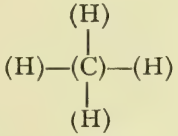
Another illustration, perhaps not quite so well known, is the almost entire replacement of the madder colours obtained by artificial means for those formerly produced from plants cultivated for the purpose. This has been the result of the purely theoretical studies of Graebe and Liebermann upon the chemical structure of the molecule of alizarin and its congeners, new knowledge which enables chemists and manufacturers to build up the colouring matters of madder, starting from the anthracene of coal tar. Indigo has not yet been produced artificially on such a scale as to compete commercially with the products of the various indigo plants, but it is possible to manufacture it by artificial means, and no doubt it is only a question of time and further research before it also will render unnecessary the cultivation of the plant, and will thus set free the ground for the production of food crops. Quinine has not yet been produced by artificial means, but the search after it by Perkin, was the origin of the first of the coal tar colours, mauve, the starting point of the enormous number of colours now available for dyeing purposes, in the production of which Germanyhas so largely beaten our own country owing to the more liberal endowments of purely scientific research by the government of that country.

But although chemists have not yet succeeded in making quinine artificially, their researches have put at the disposal of therapeutists a large number of new drugs, some of which have properties that enable them to act as more or less perfect substitutes for it. Although, here again in England, we are very seriously handicapped in the scientific struggle with other countries owing to the very severe restrictions upon animal experiments, a disability which it is hoped the foundation of the Institute of Preventive Medicine will do something to remove. A more recent illustration of the results which may follow upon purely scientific experiments is the discovery of certain new sugars by Emil Fischer, who in his experiments was guided by a purely theoretical conception of the form of the carbon atom, a theory which enabled him not only to predict the existence of certain compounds, but actually to produce them. It is, perhaps, too technical a matter to go into fully on this occasion, but I may, perhaps, not exhaust your patience if I shortly sketch the theory upon which this classical research was founded.

All chemical theories are based upon the doctrine of the atomic and molecular structure of matter, a view now so universally understood and accepted that it may be assumed almost as an axiom ; it fulfils all the conditions of the problem more satisfactorily than any other, and whenever new developments have been made, it has shown itself to be fully equal to their explanation. In my further remarks, therefore, I shall take it for granted that matter is made up of minute particles called atoms, grouped together into molecules, a molecule being the smallest particle of matter which can exist in the free state, except under certain conditions which I shall mention later on.

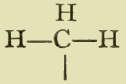
You are, perhaps, aware that at one time organic chemistry was regarded as the chemistry of the products of the organic kingdom, in contradistinction to inorganic chemistry, which was occupied with those of the mineral kingdom. The artificial production of urea from the elements, by Wöhler, in 1828, was the first blow which this distinction received, and, subsequently, many other bodies which till then had only been obtained through the intervention of plants or animals, were prepared by ordinary processes in the laboratory from their elements. It is now recognised that there is no natural distinction between the laws of formation of inorganic and organic products, but in order to divide the field, organic chemistry is now defined as the chemistry of the compounds of carbon, this element being a common constituent of all the bodies formerly called organic. It is the enormous number of the derivatives of carbon that justifies the above definition, and the existence of so many compounds is the result of the property the carbon atom possesses of being able to combine with other carbon atoms to an almost indefinite extent.

The simplest compound of carbon, and the one from which we may imagine all others to be built up is marsh gas, a combination of 12 parts by weight of carbon with 4 parts by weight of hydrogen. Chemists, for reasons I cannot enter into now, represent this compound pictorially as follows :—

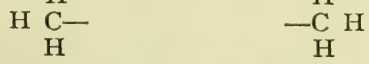


Where it will be seen the central atom of carbon weighing 12 has grouped round it 4 atoms of hydrogen, each weighing 1.

The carbon atom is said to be tetravalent—that is, it can unite with 4 monovalent atoms like hydrogen, or 4 monovalent atoms like chlorine. In marsh gas the carbon atom is said to be saturated—that is, it cannot combine with any more atoms of any kind. If we suppose one of the hydrogen atoms to be removed, the group—



is said to be unsaturated, and as such a group cannot exist by itself, it will combine with another monovalent element, like chlorine for instance, or with another monovalent group like itself, thus—



In the latter case we have 2 atoms of carbon united with one another, and it is this property of joining together that gives rise to the bewildering number of carbon compounds.

Similarly, if another atom of hydrogen is removed, and its place taken by a third unsaturated group —C H_3 we get a tri-carbon compound as follows—

$$H_3C—C—CH_3$$
$$H_2$$

and we may go on repeating this process until we get as many as 60 or more atoms of carbon thus united one to the other. I must apologise for bringing these elementary notions forward, but it is necessary for me to refer to them in the argument I am about to lay before you.

We may introduce in place of one or more of the atoms of hydrogen other equivalent atoms or groups, thus the groups —OH or —COOH will each take the place of one atom of hydrogen, and we may thus get such a compound as lactic acid, thus—

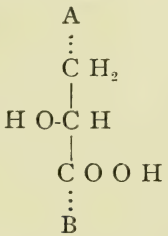
$$\begin{array}{c} H \\ H_3C—C—C\,O\,H \\ O\ \ O \\ H \end{array}$$

You will, of course, remember that wherever we use the symbol for carbon or hydrogen, it refers to a definite weight, 12 or 1, as the case may be. Now it is possible to rearrange the same elements, and to produce a body having this formula—

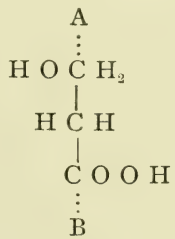
$$\begin{array}{c} H_2C—C—C\,O\,H \\ O\quad\ H_2\quad O \\ H \end{array}$$

And this body, although identical as regards weight and number of atoms with the former compound, is quite distinct in its properties and decompositions from the other body, which we call lactic acid. It is what chemists call an isomer of lactic acid—that is, it has the same number of parts, or the same percentage composition—yet it possesses different properties. It is thus that chemists explain most cases of isomerism, by a difference in the relative arrangement of the atoms of which the compound is made up, and by far the greater number of such instances of equality of composition, coupled with distinction of properties, can be thus explained. But now let us revert to the first of these two formulæ—lactic acid. This body itself is known in three different forms, characterised only by a difference in their action upon polarized light. We cannot rearrange the formula in any other way except to produce the isomer already alluded to. How then can we explain the difference between the three varieties of lactic acid? Formerly chemists had a convenient way of getting rid of the difficulty, —they simply handed it over to the physicist, and called it physical isomerism, with which they, as chemists, had nothing to do. But twenty years ago an explanation was first put forward tentatively by two chemists,—one in Holland and one in France,—and this explanation has slowly made its way to universal recognition as an adequate explanation of the phenomena. The point which has to be

explained is this. We know numerous instances of bodies which resemble one another in all respects except in one,—their action upon polarized light. You will remember that Prof. Silvanus Thompson, in one of his most interesting lectures, showed us how a plate of quartz, interposed into the course of the ray of polarized light, caused the ray to rotate to the right or the left according as it was cut from a right or a left handed crystal of quartz. Now many chemical bodies in solution have the same property,—solutions of cane sugar, grape sugar, starch, tartaric acid, and the lactic acid, I am speaking about more particularly, which I have selected because it is the simplest in constitution of all the bodies with this property. They may cause the ray of polarized light to turn to the right or to the left, and the question is, how is this property related to the chemical structure of the body ? A great many years ago Pasteur, whose scientific activity has shown itself in so many fields, opening up new lines of thought and enquiry, encountered this question, and with a peculiar foresight, seems to have hit upon the proper explanation. He found that the existence of this optical activity was associated in a remarkable manner with crystalline form, those substances which showed this optical activity also exhibiting a lack of symmetry in their crystals. He noticed that where a substance was known to exist in two different varieties, one turning the plane of polarization to the right, and the other to the left, there was a remarkable relationship in the forms of the crystals, one of them being, as it were, the reflected image of the other. The diagram of the crystals of ammonium bimalate *(shown on the screen)* will show this feature, they are, in fact, disymmetrical, and Pasteur asked himself if the atoms united with carbon had not a tetrahedral grouping. Now the Dutch and French chemists above alluded to have developed this idea by showing that in all cases in which optical activity exists the molecule is non-symmetrical—that is, a plane drawn through the centre will divide it into two dissimilar figures. Applying this to the diagram of lactic acid and its isomer, we see that in lactic acid—



Lactic Acid.



Isomer of Lactic Acid.

a plane in the direction of A to B passes through the central atom of carbon, having an atom of hydrogen on one side, and a group H O on the other, whilst in its isomer the central carbon atom has an atom of hydrogen on each side, and is, therefore, symmetrical. In other

words, where the central carbon atom is united with four *different* elements or groups, the molecule is unsymmetrical, and will show optical activity, whilst in all other cases it is symmetrical and inactive. A curious feature of these unsymmetrical compounds is that in some cases they are inactive to polarized light, and this circumstance delayed the acceptance of the theory of the assymmetric carbon atom, as it is called, until it was proved that the optical inactivity was due to compensation, one right-handed molecule neutralizing a left-handed one. In the case of racemic acid, for instance, an inactive isomer of tartaric acid, it was found that right and left-handed crystals could be picked out from one of its salts, and these could be converted into the right and left-handed tartaric acids. It was also found that certain bacteria and moulds, acting upon inactive racemic acid, would eat up one of the isomers (+) and leave behind laevotartaric acid. Dr. Percy Frankland has also found that a bacillus (*B. ethaceticus*) attacks the laevorotary glyceric acid, leaving the dextro acid, which can thus be obtained in considerable quantities. When the crystals of the calcium salt of glyceric acid are examined, they show the same development of hemihedral faces as in the case of the ammonium bimalate already mentioned. It may here be noted that the *Bacillus ethaceticus*, when cultivated for the first time in solutions of calcium glycerate, provokes only a feeble fermentation and hardly attacks the dextro-rotatory acid at all; but as it becomes more used to the work, as it undergoes what Frankland calls "educational culture," its fermentative powers become more pronounced, and the amount of the dextro-acid remaining at the end of the fermentation becomes less and less.

Most of our chemical formulæ represent the atoms as though all were contained in one plane, but this conception is, of course, utterly erroneous seeing that, small as the molecules are calculated to be by Lord Kelvin and others, they still possess extension in three directions. Nevertheless, for most purposes it is sufficient to represent the structure of bodies in that way; to the chemist they serve as little more than aids to memory, recalling the numberless decompositions undergone by chemical compounds, and no chemist regards them for one moment as really picturing the distribution in space of the atoms in a molecule. Now, however, with the notion of the asymmetric carbon atom introduced to explain differences between compounds which the ordinary formulæ are incapable of doing, we are obliged to represent the atoms in space grouped round a central atom of carbon, and for this purpose Lebel and Van't Hoff, the French and Dutch chemists already mentioned, assume that the carbon atom occupies the centre of a tetrahedron, the various atoms and groups of atoms being attached to the apices of the figure. It is immaterial whether we regard the carbon atom as itself a tetrahedron, or as being in the centre of a framework, as it were, of that shape. We have no means of knowing, and the explanation will proceed on the same lines in either case. The diagram *(shown on the screen)* will show the application of this idea to the case of lactic acid, one of the upper formulæ representing dextro, the other,

lævolactic acid. You will see that they resemble the crystals of ammonium bimalate in this, that you cannot place one above the other in any position so as to make the different groups coincide, but that one is the reflected image of the other, as though seen in a looking-glass. If now you look at the two lower formulæ you will see that they are practically identical, owing to the fact that two of the corners of the tetrahedron are occupied by atoms of the same kind.

I have taken lactic acid as the simplest case in which the asymmetric carbon atom exists—other compounds there are which contain two or more such atoms, and in every case as yet investigated, wherever optical activity is found, there are one or more asymmetric carbon atoms in the molecule. The group of the sugars which Fisher has investigated so thoroughly contains several of such carbon atoms, and the number of isomers increases very largely with the number of asymmetric carbons atoms. Starting with this theory, it is calculated that no less than 24 isomeric varieties of grape sugar should be possible, and out of this number, Fisher has shown that 13 are known, and there is very little doubt but that further research will lead to the discovery of the remainder.

In many respects the element silicon bears a very close resemblance to carbon, and it is a noteworthy fact that its combination with oxygen, silica, quartz, possesses this property of rotating the ray of polarized light, to the right in some crystals, to the left in others. These crystals also show a development of hemihedral faces similar to those in ammonium bimalate and the salts of tartaric acid. Now this circumstance leads us to ask if a similar theory of asymmetry may not be applied to the atom of silicon to help us to explain the enormous number of compounds of silicon existing all over the world as silicates. The examination of the constitution of these bodies is fraught with much greater difficulty than exists in the case of the carbon compounds, as they cannot be distilled or crystallized with the same facility, but, doubtless, in time means will be found for their more complete investigation.

It is not usual in a popular address to introduce chemical formulæ, but they are so much bound up with the ideas of chemistry that it is almost impossible to present chemical theories without making use of the symbols employed to picture the relations of atoms to one another in a molecule. They are as important to the chemist as algebraic and geometrical formulæ are to the mathematician, and it seems to me that the time has come, if we are to expect others to take any interest in our work, to make more use of them in public than has hitherto been done. I shall, therefore, make no apology for having, if only in the most sketchy manner, employed the system of chemical notation for the purpose of rendering the ideas of chemistry more intelligible.

Hitherto I have only spoken of atoms and molecules on their statical side, although we know that under ordinary conditions they are in constant movement. The commonest laws of physics

receive an adequate explanation on the view that the molecules are in constant motion, producing the effects of heat, gaseous pressure, diffusion, and so on.

But in the explanation of chemical structure it has not been found necessary to take into account the motion of the atoms contained in the molecule, although it is universally admitted that it would be contrary to all analogy to suppose them to be at rest. When, however, we turn to the borderland of chemistry and physics, we are met by problems which find no adequate solution if we are to suppose that the molecules are independent entities, that each is a world in itself, having no mutual relations except attraction or repulsion with other molecules as a whole. But the phenomena of solution and of electrolysis bring before us the need of looking at atoms and molecules from their kinetic side, and have led chemists to adopt a view of the constitution of matter which is more in harmony with modern views of the universality of motion. Here it may be noted how one branch of science touches another, for it was certain experiments on the physiology of plants which led to the modern doctrine of osmotic pressure which forms the basis of the explanation of the phenomena of dilute solutions. You all know that when a plant is deprived of water it withers. The plant cell is occupied by a soft protoplasmic matter containing sugar and salts, and limited by the cell wall. When the plant withers the protoplasmic matter shrinks within the cell, and if the plant is placed in water, the latter passes through the wall attracted by the sugar and salts associated with the protoplasm. The cell wall possesses the property of retaining sugar and salts, allowing water to pass through. This observation may be imitated in such a way as to ascertain the strength of the attraction of various salts, and the pressure exerted may be measured by means of a small pressure gauge. This is called the osmotic pressure, and it is found to be proportional to the concentration of the solution, or in other words, to the number of molecules in unit volume. Starting with this notion of osmotic pressure, similar laws have been found to obtain for dilute solutions as for gases, and just as from a knowledge of the laws applicable to gases, the relative weight of the gaseous molecule can be deduced, so the weight of the molecule in dilute solutions can be ascertained from the increase in the boiling points and the depression of the freezing points, deductions from the theory of osmotic pressure. By this means we find that the molecular weights are in general identical with those found by vapour-density determinations, with certain exceptions. And these exceptions lead us to the theory of electrolysis which enables chemists to give a satisfactory explanation of the divergence, and permits us to picture the state of things existing in any solution.

When a rod of pure (or amalgamated) zinc is immersed in a solution of sulphuric acid no action occurs, and, similarly, no action takes place if a wire of platinum is placed in such a solution. But if the two metals are placed in the same solution and the ends be made to touch, either within the liquid or externally, gas is given off from the platinum

(experiment shown), whilst the zinc dissolves in the acid, and the wires connecting the zinc and platinum outside have new properties induced, which, however, need not be considered. Similarly, if two platinum wires are placed in water acidulated with dilute sulphuric acid and connected with the two poles of a battery, the liquid is decomposed and gases are evolved, hydrogen from the cathode, oxygen from the anode, and these gases are evolved in the same relative proportions in which they exist in water *(experiment shown)*. If the current is passed through a solution of potassium sulphate, hydrogen and oxygen are given off as before, but in addition at the cathode the liquid becomes alkaline, and at the anode it becomes acid *(experiment shown)*. Other salt solutions are similarly decomposed, the products varying with the nature of the substance in solution. Now to effect ordinary chemical decompositions it is found that work has to be done, but experiment has shown that in the electrolysis of a salt no work is done in separating the elements from one another. How can this be explained, for we know that as in the combination of oxygen and hydrogen heat is produced, so in the decomposition of water into its elements heat should be absorbed, or in other words, work must be done to pull the elements apart? It used to be thought that the current of electricity decomposed water into its elements, and that the addition of sulphuric (or other) acid, merely, in some mysterious way, rendered it a conductor, for pure water will not conduct the current. Now, however, it is recognised that the acid plays a more important part, that itself undergoes decomposition, and the water is decomposed by secondary reactions. But how do we explain the fact that dilute sulphuric acid is decomposed without the expenditure of energy? Other facts have led chemists to suppose that in dilute solutions a continual interchange of partners is going on, and that the molecules of salt and solvent are by no means fixed, but that the atoms or groups of atoms (called ions) are in a constant state of decomposition. The electricity seizes hold of the free ions and they are thus carried to their respective poles, where they give up their electric charge, and are liberated as free gases. This theory of electrolytic dissociation fits in perfectly with our knowledge of the properties of dilute solutions, and completes the analogy existing between them and gases. We are now in a position to account for the exceptions to which I referred just now. In certain cases I said that the number of molecules in some liquids found by experiment did not agree with the numbers theory predicted; in these cases dissociation occurs, and we have the molecules separated into free ions, which increases the apparent number of molecules. It is these free ions upon which the electric current seizes, and thus brings about the decomposition of the liquid without the necessity of expending energy in order to do so.

In the foregoing remarks I have treated very briefly and cursorily a subject of the utmost importance to chemists and physicists, as it appeared to me that it might interest you to know something of the nature of the problems which occupy the minds of students of those sciences. I have given one or two illustrations of the bearing of

chemical theories upon the practical life of the world, but in many cases, if you ask me what is the use of it all, I can only say, I do not know. But I am sure that in the future its use will be found, if we must have something more than the intellectual satisfaction gained by penetrating the mysteries of the universe. To students, however, it is sufficient to know that—

"Science moves, but slowly, slowly, creeping on from point to point,"

and with the same poet, to feel that—

"The thoughts of men are widened with the process of the suns."

The Meteorology and Kindred Phenomena of 1894.

By FRANKLEN G. EVANS, F.R.A.S., F.R. Met. Soc., &c.

THE past year, like a white-winged ship in full sail, has floated rapidly away on the stream of time and been received into the ocean of eternity. Commencing her journey in January, the good ship *Annus* had every hope of a prosperous voyage. The winter was favourable, the spring genial, and in the fair realm of Britain there was a more than usually good prospect that the seed of the sower would, in due time, yield an abundance of bread to the eater. Later on, however, this bright anticipation became overcast with clouds and gloom; and a cold, sunless, rainy summer sadly marred in performance the rosy promise of the spring. Later in the year heavy floods deluged a great part of the country. Passing on to other climes, the buoyant craft pursued her time-consuming flight, and had a varied and chequered experience; sometimes sailing under sunny skies, and at other times driven by the tempest and whirl of the cyclone, or shaken by the roll of the thunder, and illuminated by the vivid flash of the lightning. Again she felt the shock of the earthquake, and her keel reeled on its tide-like wave. In several countries the heavens were lit up with the glare of forest fires, and the air throbbed with the wail of the stricken inhabitants. By the grace of the great Captain of all the fleet of time's ships, we are permitted to overhaul the logbook of the *Annus*, and, ere the writing fades, to place upon record the principal events of the voyage of number 1894.

The salient features of each month are given briefly in the following summary:—

January opened with a fine week, and then broke up into wet, mild, unsettled weather. S.W. winds greatly predominated, and the force

varied from light to a strong gale. The barometer was low and unsteady, with a rather wide limit of oscillation. The maximum height, 30·54 inches, was attained on the 3rd, and the minimum, 29·35 inches, on the 31st, giving a range of 1·19 inch. The instrument was below 30 inches on 24 days. The mean degree of humidity was 85, complete saturation being represented by 100. The rainfall was not very heavy, 3·21 inches, but widely distributed over 25 days. Ozone was abundant, mean degree 5·710. The mean heat was 39·1 degrees, which is 2·2 degrees above Greenwich average of 50 years without correction. There was frost on 12 days, very severe on the 5th and 6th. An anti-cyclone ruled for the first few days, afterwards cyclonic movements until the end of the month. The hazel bloomed on the 21st, and the song thrush was first heard on the 12th.

FEBRUARY was a warm, wet, windy month. W. winds much preponderated, sometimes of considerable force. The barometer was unsteady, but not very low. The maximum height, 30·50 inches, was reached on the 19th, and the minimum, 29·57 inches, on the 12th; range ·93 inch. The mercury stood below 30 inches on 11 days. The mean degree of humidity was 88. The rainfall was heavy and frequent. It amounted to 4·90 inches, and fell on 20 days. The greatest fall in 24 hours was 1·18 inch on the 17th. Ozone was highly developed, mean degree 6·321. The average temperature was 42·8 degrees, which is 4·1 degrees above the mean. There was frost on 8 nights, but no snow. With the exception of an anti-cyclone from the 18th to 22nd inclusive, the air movements were wholly cyclonic. The coltsfoot was in blossom on the 3rd.

MARCH was very wet during the first half of the month, and fine afterwards. W. winds of moderate force prevailed. The barometer was fairly high, but fluctuated widely. The maximum height, 30·45 inches, occurred on the 23rd, and the minimum, 29·21 inches, on the 13th, range 1·24 inch. The reading was below 30 inches on 14 days. The mean degree of humidity was 79. The rainfall was 3·67 inches, spread over 15 days. The mean degree of ozone was 5·000. The mean heat was 46 degrees, which is 4·4 degrees above the average. The mean daily range was 16·8 degrees. There was frost on 7 nights. Cyclones held sway in the first half of the month, anti-cyclonic conditions afterwards. The wood anemone bloomed on the 13th, and the blackthorn on the 17th. The honey bee was seen on the 11th, and wasp on the 23rd.

APRIL was very mild and equable, with alternations of fine and wet weather in due proportion. E. winds were in excess, but shorn of their harsh quality by a large amount of S. in combination. The force was moderate. The barometer was fairly high, with a limit of fluctuation under an inch. The maximum height, 30·18 inches, was recorded on the 20th and 29th, and the minimum, 29·28 inches, on the 16th, range ·90 inch. The pressure was below 30 inches on 19 days. The mean degree of humidity was 77. The rainfall was light, 1·91 inch, and divided over 14 days. Ozone good, mean degree 5·200. The

temperature was warm, the mean 52·0 degrees, which is 5·8 degrees above the average. There was no frost here. Cyclones and anti-cyclones alternated in about equal ratio. Garlic hedge mustard bloomed on the 4th, horse chestnut on the 6th, and hawthorn on the 23rd. The first swallow was seen on the 11th, and the cuckoo heard on the 6th. The small white butterfly was first seen on the 11th, and the orange tip on the 13th.

MAY, also, was a month of moderate conditions, wet and dry weather alternating in equal proportions, but it was rather cold. N.W. winds of no great force predominated. The barometer was rather low, with a narrow limit of oscillation. The maximum height, 30·36 inches, was registered on the 1st, and the minimum, 29·62 inches, on the 29th, range ·74 inch. The record was below 30 inches on 16 days. The mean degree of humidity was 71. Rainfall was rather light, 2·26 inches, distributed over 14 days. Ozone was abundant, mean degree 5·484. The mean heat was 51·6 degrees, which is 1·3 degree under average. The mean daily range was 17·5 degrees. There was frost on two nights. At the end of the month thunder, lightning, and hail occurred. The air movements were mixed cyclonic and anti-cyclonic, with a preponderance of the former. The white ox eye daisy bloomed on the 5th, and dog-rose on the 26th. The fly-catcher was first seen on the 20th, and meadow brown butterfly on the 7th.

JUNE was generally cold and unsettled, with frequent but not heavy rains. W. and S. winds, brisk and fresh, preponderated. The barometer showed frequent changes within moderate limits of variation. The maximum height, 30·36 inches, was attained on the 30th, and the minimum, 29·66 inches on the 2nd, range 70 inch. The instrument stood below 30 inches on 12 days. The mean degree of humidity was 75. Rainfall was not heavy, but spread over 16 days. It measured 2.35 inches. The greatest fall was ·62 inch on the 3rd. Ozone rather scanty, mean degree 4·467. The temperature varied from a maximum of 81 degrees to a minimum of 40 degrees, total range 41 degrees. The mean heat was 59·2 degrees, 0·1 below average. Cyclones mainly prevailed up to the 23rd, then an anti-cyclone brought brilliantly fine, hot weather.

JULY commenced with a few fine days, then a period of very unsettled weather, with much rain, set in. S.W. winds, sometimes strong, were greatly in excess. The barometer was low and unsteady. The maximum height, 30·27 inches, was reached on the 1st, and the minimum, 29·37 inches on the 12th, range ·90 inch. The mercury was below 30 inches on 20 days. The mean degree of humidity was 75. The rainfall was heavy and continuous. It amounted to 5·06 inches, and fell on 21 days. The greatest fall was 1·71 inch on the 24th. Ozone moderate, mean degree 4·548. The maximum temperature was 85 degrees on the 1st, and the minimum, 47 degrees on the 5th and 6th, range 38 degrees. The mean heat was 63·1 degrees, which is 1·3 degree above the average. The month began with an anti-cyclone, but the air movements subsequently were mainly cyclonic.

The black knapweed blossomed on the 2nd, the greater bindweed on the 11th, and the harebell on the 19th.

AUGUST was cold, wet and ungenial. W. and N. winds of moderate force were in excess. The barometer was rather low and unsteady. The maximum height 30·28 inches, occurred on the 29th and 30th, and the minimum 29·42 inches on the 2nd, range ·86 inch. The pressure was below 30 inches on 18 days. The mean degree of humidity was 79. Rainfall was heavy, 4·85 inches, and was distributed over 19 days. The greatest fall in 24 hours was 1·70 on the 25th. Ozone well developed, mean 5·774. The highest temperature was 74 degrees on the 1st and 26th, and the lowest 45 degrees on the 21st, range 29 degrees. The mean heat was 60·2 degrees, which is one degree under average. Thunder and lightning occurred on several occasions. Cyclones ruled the month excepting on the last five days, when an anti-cyclone prevailed.

SEPTEMBER showed a marked improvement on the previous months, and was blessed with a good deal of fine, genial weather. N.E. winds of light force prevailed. The barometer was high and steady. The maximum height, 30·50 inches, was recorded on the 30th, and the minimum, 29·70 inches on the 25th, range ·80 inch. The reading was above 30 inches on 23 days. The mean degree of humidity was 80. The rainfall was not very heavy, 3·08 inches, and restricted to 10 days. The mean degree of ozone was 5·733. The mean heat was 55·0 degrees, which is 1·06 below the average. There was a little thunder, lightning and hail. The air movements were principally anti-cyclonic. The ivy bloomed on the 17th.

OCTOBER commenced with a continuance of the fine conditions that distinguished the previous month. After the 18th a remarkable change set in, and an unusually wet period began, and lasted far into November. N.E. winds predominated, and the force was fresh to a gale in the latter part of the month. The barometer was high on the whole, but oscillated through a wide limit. The maximum height, 30·51 inches, was registered on the 1st, and the minimum, 29·11 inches, on the 25th, range 1·40 inch. The instrument was above 30 inches on 17 days. The mean degree of humidity was 86. The rainfall was heavy, 5·40 inches, and fell on 17 days. Ozone 4·839. The mean heat was 51·1 degrees, barely one degree above the average. There was no frost. Thunder, lightning and hail occurred on several days between the 20th and 29th. The air movements were entirely anti-cyclonic up to the 18th, and cyclonic afterwards. Swallows were last seen on the 11th.

NOVEMBER was extremely mild and wet until the 20th, and then fine. S.W. winds, sometimes fresh to a gale, preponderated. The barometer was low and unsteady in the first part of the month, but high and steady in the latter part. The maximum height, 30·47 inches, was attained on the 30th, and the minimum, 29·06 inches, on the 14th, range wide 1·41 inch. The mercury was under 30 inches on 15 days. The mean degree of humidity was 88. The rainfall was heavy and

continuous until the 20th, and caused great floods. It amounted to 5·34 inches, divided over 20 days. The highest temperature was 62 degrees on the 2nd, and lowest, 34 degrees on the 21st, range 28 degrees. The mean heat was 47·2 degrees, 4·1 degrees above the average. There was no frost. Cyclones prevailed until the 16th and, anti-cyclones afterwards.

DECEMBER was generally mild and wet, and in the latter part windy. N.W. winds prevailed, and the force amounted to a severe gale on two occasions. The barometer was usually high, but often unsteady, with a rather wide limit of fluctuation. The maximum height, 30·68 inches, was reached on the 27th, and the minimum, 29·47 inches, on the 22nd, range 1·21 inch. It fell almost an inch in 24 hours, between the 28th and 29th. The pressure was above 30 inches on 20 days. Humidity 88. Rainfall was moderate, but continuous. It measured 3·78 inches, and fell on 20 days. The mean degree of ozone was 5·355. The mean heat was 41·9 degrees, which is 2·1 degrees above the average. There was frost on 7 nights. The month began with an anti-cyclone up to the 4th, inclusive. The remainder had a curious mixture of cyclonic and anti-cyclonic movements that acted and reacted on each other, and produced very unsettled and contradictory types of weather.

The chief characteristics of the year are analysed and summarised in the following table :—

WIND-DIRECTION, BAROMETER, RAINFALL, &c.; OZONE AND TEMPERATURES.

1894.	More or less Westerly—Days.	More or less Easterly—Days.	Combined with Southerly—Days.	Combined with Northerly—Days.	Barometer below 30 inches—Days.	Mean degree of humidity.	0·01 in. or more of Rain fell—Days	Rainfall Total—inches.	Maximum fall in 24 hours.	Mean degree of Ozone.	Maximum temperature.	Minimum temperature.	Total range.	Greatest daily range.	Least daily range.	Mean daily range.	Mean of maximum temperatures.	Mean of minimum temperatures.	Mean temperature of the month.	Difference from average of 50 years.
January	21	9	17	11	24	85	25	3·21	·37	5·710	53	14	39	24	1	10·9	44·6	33·6	39·1	+2·2
February	22	6	9	12	11	88	20	4·90	1·18	6·321	54	26	28	20	1	11·9	48·7	36·9	42·8	+4·1
March	18	13	13	13	14	79	15	3·67	1·25	5·000	64	30	34	27	7	16·8	54·4	37·6	46·0	+4·4
April	8	22	16	9	19	77	14	1·91	·40	5·200	68	37	31	27	8	17·1	60·5	43·5	52·0	+5·8
May	17	13	8	20	16	77	14	2·26	·40	5·484	67	35	32	27	8	17·5	60·4	42·9	51·6	—1·3
June	22	8	15	12	12	75	16	2·35	·62	4·467	81	40	41	30	8	18·2	68·3	50·1	59·2	—0·1
July	22	9	20	9	20	75	21	5·06	1·71	4·548	85	47	38	36	11	19·0	72·6	53·6	63·1	+1·3
August	24	7	9	15	18	79	19	4·85	1·70	5·774	74	45	29	24	3	16·8	68·6	51·9	60·2	—1·0
September	4	26	5	23	7	80	10	3·08	·86	5·733	70	39	31	25	4	14·4	62·2	47·8	55·0	—1·6
October	12	19	13	17	14	86	17	5·40	1·10	4·839	67	34	33	20	5	12·1	57·2	45·1	51·1	+0·9
November	21	8	15	9	15	88	20	5·34	1·36	5·567	62	34	28	19	2	10·7	52·6	41·9	47·2	+4·1
December	17	14	8	21	11	88	20	3·78	·60	5·355	54	27	27	21	2	10·5	47·2	36·7	41·9	+2·1
Totals and Means	208	154	148	171	181	81	211	45·81	11·55	5·333	*85	†14	71	‡36	§ 1	14·7	58·1	43·5	50·8	+1·8

* July 1st. † January 6th. ‡ July 6th. § January 22nd and February 14th.

In this table the first two columns give the number of days on which the winds were westerly and easterly respectively. The third and fourth columns show the proportion in which southerly and northerly directions were combined with the other two quarters. The figures indicate a large excess of westerly, and a smaller one of northerly winds.

The barometer was not so high, and did not fall so low as in the previous year, and the limit of oscillation was not so wide, but within the narrower range it was more unsteady. The maximum height, 30·68 inches, was attained on December 27th, and the minimum, 29·06 inches, on November 14th, giving a total range of 1·62 inch. The instrument stood below 30 inches on 181 days.

Humidity was high—above that of any year since 1889, and four degrees in excess of that of Jubilee year and 1893. The highest monthly mean was 88 in February, November and December, and the lowest, 71, in May. The mean degree of humidity was 81. Complete saturation being represented by 100.

Rainfall in 1894 was heavy. It was the same as that of 1891, and was only exceeded of late years by that of 1886. The driest month was April, 1·91 inch, and the wettest months were July, October, and November, with totals exceeding 5 inches. The total rainfall at Llwynarthan was 45·81 inches, which is equal to 4,627 tons, or upwards of 19,000 hogsheads to an acre. The number of wet days was 211, which is considerably above the average of the last ten years, and shows the dripping-wet character of the year. The sum of the maximum falls in 24 hours was 11·55 inches, about one-fourth of the total quantity. The rainfall in the Society's Field is given in the following table, arranged in the order of elevation above sea-level :—

1894.	Feet above Sea Level.	Inches.
J. A. B. Williams, Taff Fawr	1328	89·43
G. A. Lundie, Bargoed	1237	52·45
Wm. Jones, Castell-Nos, Pontypridd	1110	67·41
George Palmer, Penwyllt, Brecon	1108	80·41
Edward Martin, Gwernllyn, Dowlais	1035	63·04
G. A. Brown, Tredegar	1024	69·97
Forster Brown and Rees, Glyncorrwg	717	99·92
W. T. Lewis (Sir), Treherbert	670	95·29
Mrs. Cowburn, Dennel Hill, Chepstow	573	42·05
E. J. Lowe, F.R.S., Shirenewton, Chepstow...	530	55·32
W. T. Lewis (Sir), Mardy, Aberdare	431	72·07
Evan Jones, Aberdare	430	73·25
W. E. C. Curre, Itton Court, Mon.	370	47·00
T. Hutchins, Gwernyfed Park, Three Cocks, Brecon ...	350	38·24
F. J. Mitchell, Llanfrechfa	326	49·33
Daniel Owen, Ash Hall, Cowbridge	315	48·29
D. Herbert Lewis, Ystalyfera	300	66·10
Wm. Jones, Reservoir, Pontypridd	300	65·91
Godfrey L. Clark, Talygarn, Glam.	300	56·98
Henry Clay, Piercefield, Chepstow	300	43·25

1894.	Feet above Sea Level.	Inches.
Hy. M. Jackson (Sir), Llantilio Court, Abergavenny ..	207	41·60
Edwin C. Pole, Neath	204	54·35
Lord Llangattock, The Hendre...	176	38·02
J. A. B. Williams, Lisvane	135	39·96
O. H. Jones, Fonmon Castle	130	50·53
J. A. B. Williams, Cogan	121	40·30
J. H. Canning, Aragon House, Newport, Mon.	100	49·11
Iltyd Nicholl, The Ham	96	36·87
Franklen G. Evans, F.R.A.S., Llwynarthan...	72	45·81
George Evans, The Rest, Porthcawl	60	42·00
J. A. B. Williams, Ely	53	45·85
A. Pettigrew, Castle Gardens	39	41·79

These returns show a considerable excess of rainfall over the whole district, and, compared with the previous dry year, indicate an increase varying from 8 to over 20 inches, according to the locality. The Llwynarthan total was exactly 10·50 inches above the average of the previous 9 years. The distribution generally maintained the usual rule of increase in proportion to altitude above sea-level and westerly position. That is in its local aspect, but there is another very important factor in rainfall distribution, viz., the direction taken by cyclonic movements across the country, or skirting our shores. A cyclonic area has certain definite kinds of weather in its various parts in relation to its centre, such as heavy rain in front and showers behind, &c., and outside its path the conditions may be comparatively fine. The highest total was again that of Glyncorrwg, 99·92 inches, followed by Treherbert, 95·29 inches, and Taff Fawr, 89·43 inches. This is exactly the same order in the wet year just past, and the dry one of 1893. The lowest reading, as usual, was that of The Ham, 36·87 inches, but the neighbouring Fonmon gauge had an unusually high total, 50·53 inches, which indicates the occurrence of exceptionally heavy local storms. Speaking generally, there were in most places a good number of falls exceeding an inch in 24 hours. These are the main items of the pluvial account of the past year, and the figures are collected for us by a united though a scattered band of workers, to whom our thanks are warmly due. One, we regret to say, died in the early days of the new year—Mr. D. Herbert Lewis, Tan-yr-Allt, Ystalyfera—but his work survives him in this volume of Transactions.

Great Floods.—The heavy rains that continued so steadily from October 19th to November 22nd flooded this district to a great extent. The moors were under water in many places, and the approach to Marshfield Station was covered to a depth of many feet, so that vehicles floated, to the alarm and peril of their occupants. But the conditions of rain and floods were infinitely worse in other localities. Many parts of North and South Wales suffered severely. Ireland had large tracts of land submerged. The severest inundations, however, were in the

valleys of the Thames, Severn, and Avon. Windsor, Eton, Maidenhead, and Reading suffered severely. At Windsor and Eton the houses were deeply flooded, and the inhabitants imprisoned in their watery tenements. The ordinary street traffic had to be carried on in boats, food and other necessaries thus supplied, and, where needful, the alarmed occupants of the dangerous dwellings were rescued. The gas and water works were so deeply submerged that the manufacture of gas ceased, and the water that could be supplied was impure and scanty. The flood was the highest since the memorable one in November, 1852, at the time of the Duke of Wellington's funeral, which it exceeded by 4 inches. Eton college was drowned out, and the boys all sent home, no doubt to their great regret! Stroud was deeply inundated, and a landslip occurred which impeded railway traffic. Gloucester was a fresh water sea, thousands of acres being flooded. A storm-cloud burst over the Forest of Dean to add to the raging waters. Railway traffic was suspended near Oxford, and at other places. At Monmouth, also, the floods were severe. Bath suffered very much in the same way, and to a similar extent, as Windsor and Eton. It is evident that the rainfall over the water-sheds of the three rivers was unusually heavy and continuous. It is very necessary to keep a permanent record of the height of floods, and their highest limit should be marked along the course of rivers, and the towns down the stream should receive timely notice of the rising waters in the upper reaches of the rivers.

Ozone was abundantly generated, and much in excess of that of the previous dry year. This is the natural result of the prevalence of west winds and much moisture, which are so favourable to its production. The mean degree in 1894 was 5·333.

Temperature during the past year was well above the average, though not so much so as in the hot year of 1893. The maximum reading of the thermometer in the shade, 4 feet above ground, was 85 degrees on July 1st, and the lowest night record in the same position, 14 degrees on January 5th, showing the wide range of 71 degrees. The greatest daily range was 36 degrees on July 6th, the least variation 1 degree on January 22nd and February 17th, and the mean daily range, 14·7 degrees. The mean of the maximum temperatures was 58·1 degrees, and of the minimum, 43·5 degrees. The mean heat of the year was 50·8 degrees, which is 1·8 degree above the Greenwich average of 50 years without correction. Speaking generally, the winter months were very mild, and the so-called summer ones, cool and damp. There were a few very cold days in January, the lowest temperature here was 14 degrees, but in some parts of the country it was down below zero. It is unfortunate that the critical months of harvest were so wet and sunless, in a year of generally mild temperature.

Thunderstorms of considerable severity were prevalent in many localities. They were generally associated with cyclones or secondary depressions, and accompanied with hail of unusual size. On February 17th, at Kilkee, County Clare, a severe thunderstorm, a man and four

children seated round the fire were injured, and a cat's head burned off. March 1st, Glasgow visited by great thunderstorm and wind, Provan-mill Distillery struck by lightning and set on fire, and whisky burned. April 3rd, Bradford, stable injured by lightning and horses killed. 11th, heavy thunderstorm passed over North Wales and Cheshire, large hail, a man killed. 18th, Hampton Court Palace struck by lightning, and other places. Marseilles, thunderstorm, hailstones as large as walnuts, much damage. June 7th, Vienna, thunderstorm with great hail and hurricane. July 25th, West Yorkshire, thunderstorm, two persons killed and one injured. Chester, thunderstorm, with large hail. Sheffield, thunderstorm, houses struck and fired. 29th, Thames Valley, thunderstorm, floods and other damage. South Somerset, Norton-sub-Hamdon Church set on fire and bells melted. August 5th, Thannington, near Canterbury, thunderstorm, a fly driver, waiting under a tree for a wedding party, was killed. 10th, Bassett, Texas, thunderstorm, seven children sheltering under a tree were killed by lightning. North of England, thunderstorm and heavy rain, embankment of North Eastern Railway, between Newcastle and Carlisle, washed away. Warminster, thunderstorm, two persons killed. 15th, Holbeach, severe thunderstorm, two men killed. 25th, Reading, the theatre fired by lightning and totally destroyed, other buildings damaged. South Wales, great thunderstorm and rain, house at Iron Bridge, near Morganstown, Taff Valley, was struck by ball-lightning, close to house stood an old tree which was first struck and splintered. It then passed into the house, where was a large family, who miraculously escaped. Windows, doors, and furniture were smashed, and the floor was upheaved. Barry also was severely visited, lightning passed down a telephone pole, entered shop of Mr. Ward, butcher, and set fire to woodwork. 26th, Belgium, near Mons., thunderstorm, several farms struck and burned down; enormous hail that did much damage; this storm also visited Liêge. 27th, Laurahütte, Silesia, great thunderstorm, with hail and wind, hailstones very large and smashed thousands of windows; trees blown down; railway carriages blown loose and driven along the line with much velocity, and workmen run over; two men killed by lightning. 29th, Austria visited by great hailstorm, stones of large size, and killed three children. September 5th, Aldershot, a captive balloon was struck by lightning, and the electric current conveyed by the wire severely injured three engineers at the winch by burns and shock; several trees were struck. Churn, military camp visited by great hailstorm and wind, camp drenched by melting hail. 25th, Inverness, thunderstorm, four men and donkey killed, one man, apparently uninjured, lost his reason from shock. Severe thunderstorms in France. Maldon, Essex, thunderstorm, with deluge of rain, houses damaged. October 9th, Vienna, thunderstorm and cloud burst, signal box struck; hail three feet deep; railway traffic suspended; cows, horses, and pigs swept away. 19th, Cordova, Spain, thunderstorm and floods. Belgrade, also, with hail as large as pigeon's eggs;

great damage to glass and roofs. 20th, Torquay, thunderstorm, and rain and flood, some men at work in a sewer were saved with difficulty, one was drowned. November 9th, Venezuela, cloud burst, 150 people drowned; crops devastated.

STORM PREDICTION.—Prof. Falb, of Vienna, issued a forecast of the nine most stormy days in the year, given in the order of greatest intensity from 1 to 9. Having taken notes of the results, it may be interesting to record them in this paper :—

FORECAST.	ACTUAL WEATHER.
1. August 30th	Very fine and calm, anti-cyclonic.
2. September 29th	Very fine, light breeze, anti-cyclonic.
3. February 20th	Calm, brilliantly fine, anti-cyclonic.
4. March 21st	Very fine and calm, anti-cyclonic.
5. August 1st	Fine, hot, light breeze.
6. April 6th	Fine, calm, warm, anti-cyclonic.
7. January 21st	Mild, showers, fresh.
8. May 5th	Very fine and bright.
9. October 28th	Fine, light breeze, pm. rain.

The nine most stormy days were very perversely quiet ones. The only day on which a fresh breeze blew was on January 21st. All the other days were calm or light, and five out of the nine were anti-cyclonic.

EARTHQUAKES in 1894 were numerous and destructive. In our own country a severe shock was felt at Lynton, North Devon, on January 25th, at 9 a m. Pontypridd was visited by an alarming earthquake at 3 p.m. on April 11th, with subterranean reports, suggestive of colliery explosions, and at the Great Western Colliery the men ran for their lives, believing that an explosion had actually taken place. The shock threw trams off the rails and men to the ground. In the same district another shock occurred on May 2nd. Abroad, Greece suffered severely, also Spain, Japan, South America, and many other places, but space forbids a detailed account.

LADY DAY, EASTER.—Easter Sunday, in 1894, fell on March 25th, and called up old superstitious fancies in connexion with the rather uncommon coincidence. The old saw says—

"When Easter falls in our Lady's Lap,
Let England then beware a rap."

There are other very similar versions. During the past 900 years Easter has happened on March 25th 22 times, with extremely variable intervals. Thus, there was a long one of 139 years, one of 79, two of 84 (73 and 11), five of 73, and 13 of 11 years. It may interest some to look back through the ages for possible fulfilments of the saying. In the past year the events that occurred may be mishaps or the reverse, according to the mental or political bias of the individual. The intervals are peculiar, and suggest some law of recurrence which is not at present very clear.

Snake Cannibalism.—In October, at the Zoological Gardens, a boa constrictor swallowed one of its mates. The culprit was 9 feet long, and the victim 8 feet, but the difference in bulk was more considerable. It is believed that the crime was not premeditated, but that it began in a mere act of larceny. He seized a part of a pigeon projecting from the smaller boa's mouth, and that the rest of the deed was involuntary —reflex action in fact. The penalty was some month's indigestion.

Agriculture in 1894 was not very prosperous. It showed the same dogged persistency in ill luck which has characterised it, more or less, for so many years. The year commenced with every prospect of a good season. A hard frost pulverised the soil, and a fine pleasant spring followed, which was very favourable to farming operations; and for nearly the first half of the year all was bright and hopeful. A fair mixture of moisture and sunshine pushed on vegetation in a highly satisfactory manner. The "hope that springs eternal in the human breast" began to nestle in the bosom of the farmer, but alas! it was soon found to "tell a flattering tale." With the turn of the year a dire change came over the scene, chill days, heavy rains, and the absence of sunshine entirely changed the aspect of affairs. Splendid crops were grown, but could not be well ripened owing to the dearth of sunshine, and, also, were ill-garnered from the sad want of fine harvest weather. Crops were badly laid by the rain and wind, which precluded to a great extent the use of machinery, and made reaping difficult and costly. The old truth was again realised, that a bad harvest is also an expensive one. Autumn brought but little improvement, and the ill-matured and discoloured grain, which had to be threshed and marketed by farmers in need of money, was sold at absurdly low prices, even 16s. to 17s. a quarter, thus surpassing the lowest previous record. Hay crops were heavy and good, but like those of grain were considerably damaged by the miserable harvest weather. Root crops which revel in abundant moisture, found 1894 too much for them, and suffered from the incessant rain. Potatoes, also, were injured, and some disease was manifested. Pastures, stock-breeding and grazing were the best features of the year, and did much to diminish loss, and to throw something into the scale of profit. The heat of 1893 left the fields rather bare, but growth started early in the spring, and throughout the year grass was sweet and abundant. Flock-masters were quite as fortunate as cattle owners, and had a prosperous time.

Cattle Poisoned by Ferns.—Throughout the country, wherever obtainable, the common bracken fern—*Pteris aquilina*—is largely cut, stacked and used for bedding live stock in winter. It is, also, more or less eaten by cattle, horses and pigs, and no one ever supposed that the food was otherwise than wholesome. In the New Forest last summer some cattle fed greedily on fern, and got a disease resembling anthrax, and which at first was mistaken for it. Suspicion fell upon the bracken, but it seemed incredible that, if poisonous, the fact could have been so long overlooked. According to the *Journal of Comparative Pathology*

and Therapeutics, some experiments in feeding were tried that left no doubt of the injurious, and even fatal effect of fern in large quantities. A number of animals were given bracken, chopped with straw, then the straw was gradually withdrawn until fern only was left, with a little turnip. The animals became very ill, and three died. A *post mortem* examination of the bodies revealed symptoms identical with those exhibited by the cattle that died in the summer, and there is good ground for believing that at least one large herd, in which a few cases of fern poisoning occurred, was slaughtered under the mistaken impression that the malady was anthrax. There is a difference in the symptoms. The abnormal temperature is higher in fern-poisoning than in anthrax, but the course of the complaint is gradual, and so time is given to study the symptoms. In anthrax the course is very acute, and animals sometimes die before they have been observed to be ill. In cases where cattle, sheep and horses have been pastured on fern, the cattle only were effected, not so in anthrax. From our experience in this part of the country, it would seem that excessive quantity is the great source of danger, and farmers cannot obtain bracken in a perilous amount.

Another curious case of poisoning occurred at Bristol amongst the horses of the Tramways Company, by which 100 were affected and nine died. The horses from a state of prime condition began to collapse, and to fall down paralysed in the middle of their work. It was ultimately discovered that the calamity was caused by an article of food contained in a parcel of Indian peas, or that was bought as Indian peas. This was an Indian vetch—*Lathyrus Sativus*—actively poisonous. This is a singular exception to the generally useful and valuable qualities of the *Leguminoœ* as food for man and beast, and shows that we must not always credit the fine character of a good family to all its individual members.

HEALTH AND LIFE in 1894. The past year was favourable to life and health, though, perhaps, not to comfort. Cool, wet summers are more conducive to the maintenance of life and good health than the more enjoyable hot and dry ones. The same may be said of moist, mild winters, in comparison with cold, rigorous "old-fashioned" ones. There is no truth in the old saying "A green yule maketh a fat churchyard." The 33 large towns of England and Wales, with a population of 10,500,000, had an average death rate of only 18·1 per thousand, which is by far the lowest rate on record, and as much as 3·2 per thousand below the mean of the previous ten years—1884 to 1893. In 1890, the rate was 21·8; in 1891, 22·3; in 1892, 20·7; and in 1893, 21·6; so that, compared with these four years, there was a remarkable improvement of 3·5 per thousand. This means that only five persons died in these towns in 1894, instead of six in each of the other years mentioned. It may be fairly assumed that the mortality in small towns, villages, and the country generally, showed a similar reduction. There was an increase, however, in the first half of January, from the intense cold that prevailed. There was a fair amount of influenza, measles,

scarlet fever and diptheria, but the resulting mortality did not efface the favourable record. Cholera raged with fatal effect on the Continent, but the cool, wet weather, and sanitary precautions sufficed to exclude it from this country. The low mortality did not find much favour amongst undertakers. At Coventry a bankrupt member of that lugubrious calling, attributed his failure to the unusually low death rate, as, like Othello, he found his occupation gone. The Official Receiver admitted that it was bad for him, but good for the lucky survivors. At Cardiff, the interments in the Cemetery were considerably under the average.

Typhoid Fever and Oysters.—During the latter part of the year numerous cases of typhoid seem to have been caused by eating raw oysters. Sir Wm. Broadbent, Bart., M.D., has published an account of a good many cases in which raw oyster-eating was the sole common factor in every instance. The sanitary surroundings in all the cases were entirely satisfactory, and no other members of families were attacked except those who had eaten oysters. Many of the cases were of a severe type, and some were fatal. The evidence was so strong that the oysters were the sole cause of the malady, that it produced conviction in Sir William's mind, and he felt it his duty to make the facts known, so as to prevent the spread of the disease, and to stop the contamination of oysters by the typhoid poison, which is probably accidental, and not of frequent occurrence.

This is not the first occasion on which the oyster has fallen under suspicion. A similar stigma of doubt occurred in Dublin, in 1890, with regard to certain cases, and in 1880 Sir Charles Cameron reported cases of disease of a similar character at the Cambridge meeting of the British Medical Association.

Further strong evidence comes from the other side of the Atlantic. Dr. Conn, Professor of Biology at the Wesleyan University, Middletown, Connecticut, reported in the *Medical Record* of New York, a limited epidemic of typhoid fever in the autumn of 1894, amongst the students of the University, which was almost certainly caused by oysters. The College has male and female students, but the males only suffered. Air, water, foods, and sanitary surroundings were excellent. The male students are organized into seven fraternities of the nature of clubs. The cases of typhoid, with three exceptions, occurred amongst three of these fraternities, numbering 100 members, and they furnished 25 out of 28 cases. There must have been some special cause at work in these fraternities. All causes seemed to be excluded except that of oysters. On October 10th, eight days or so before the first case, each of the three fraternities gave a supper, and they were all supplied by the same dealer with oysters, which were eaten raw. Of the other four fraternities, two had no oysters, a third had cooked oysters, and the fourth was supplied from an entirely different source. One of the three sufferers, outside the three fraternities, had been a guest at one of the suppers, another had eaten of the raw oysters at the store of the dealer. Certain other guests had been present, including some old students.

Of these, two had typhoid fever at the same time as the outbreak at the College, three others had less severe illness, and two students of Yale had typhoid. The source of the oysters was then traced, and it was shown that they had been grown in the deep water at Long Island Sound. Then they were deposited in the mouth of a fresh water stream to "fatten," as it is termed. It was ascertained that within 100 yards of this spot was the outlet of a private sewer, coming from a house in which were two cases of typhoid fever. The oysters, therefore, had been put to "fatten" on the microbes of typhoid. At Amherst College several cases of the disease broke out amongst the members of a fraternity who had eated raw oysters at a supper on October 12th, and these had been fattened in the same creek. This chain of evidence goes very far to convict the oyster, and to point out the remedy. Streams should not be polluted with sewage, and when they are, some steps should be taken to find out whether they are free from specific infection before the oysters are deposited near their mouths. In addition to this source of danger, it may be mentioned that large quantities of oysters are bred in tanks on the French and Belgian coasts, in which the water is foul from the slowness of the current, and the bivalves consequently injurious.

Dr. Charles Graham Grant states that three out of four persons who partook of about 1½ dozen oysters each, at a shop in the city, were attacked with very severe typhoid.

Sir Peter Eade, M.D., reported an epidemic of typhoid fever at Norwick some years ago, which principally affected the poorer classes. A Government Inspector was sent down. Sir Peter, in the absence of any insanitary conditions, attributed the disease to mussels, and this view was adopted in the Report to the Local Government Board. Mussels, like their more aristocratic relations, the oysters, are stored in the estuaries of rivers until wanted for sale, and it must occasionally happen that typhoid sewage will contaminate them with injurious results. Typhoid is a specific disease, and if no germs existed, sewage as such, though unpleasant, would not produce the complaint. Oysters, being fixed, cannot escape from the vile contamination, they can only close their shells, but that, of course, could not be for long. The remarkable manner in which oysters are affected by their food is shown by the *huitre de Marennes* or green oyster, esteemed by our Gallic neighours a great delicacy, the colour of which is produced by feeding on blue diatoms, and when these are withheld they soon lose their peculiar colour.

Some time ago I had occasion to refer to oysters and fish as a probable source of infection in reference to cholera at Great Grimsby. Typhoid and cholera are both water-borne diseases, and what is true of one is so of the other. They are cousins in mode of propagation, and in the haunts they infest. It is found that as typhoid—which is with us more or less every year—is diminished by sanitary measures, so the occasional cholera visitant finds its favourate haunts swept and garnished and no longer suitable for its cultivation.

Fish and Food Habits.—The risk of infection varies with the kind of fish, as habits differ. According to Mr. Lawrence-Hamilton, an authority on this subject, trout are clean feeders and avoid sewage. Cod, turbot, sprats, herrings, pilchards, oysters, mussels, scallops, lobsters, crabs, &c., are fond of sewage water in moderate amount. Grey mullet, eels, tench, and carp revel in extreme pollution. Hence the necessity of thoroughly cleaning and cooking fish to avoid risk, but this is not always done. Whitebait are eaten whole and uncleaned, and are often taken at sewer outfalls, so everything depends on thorough cooking. Oysters are commonly eaten raw, and other shell fish, such as scallops, mussels, and cockles after moderate cooking. Although all this is done with comparative impunity, it is evident that in cases of exceptional water pollution, as in epidemics of typhoid, cholera, &c., much peril may be incurred, as was the case with cholera in 1892, at Great Grimsby.

Forest Fires.—The year 1894 will be memorable for the number and intensity of the forest fires that raged in many parts of the world, and the vast destruction of life and property that resulted from them. At the end of August great fires were reported from British Columbia, on the mainland and across the Straits. The Island of San Juan was burned from end to end, and everything destroyed which could not be removed. About the same time extensive conflagrations broke out in America, mainly in Minnesota and Wisconsin, 500 lives were lost, and the towns of Hinckley, Sandstone Junction, Pokegama, Skunk Lake and Mission Creek, in Minnesota, were destroyed, and many in Wisconsin. The town of Hinckley was burned down, and numbers perished in the flames. Many escaped into the woods, which subsequently caught fire, and most of them lost their lives. The country for miles round was a sea of flame. Some passengers by a train that had been abandoned at Hinckley, drove off in a hand-car, and were badly burned in traversing the blazing forest. They reported 40 bodies found along the line. The other passengers from the train, which was burned, took refuge in a swamp, surrounded by a ring of fire. A woman, trying to save her children, was overtaken by the flames, and the whole family perished. Numerous similar disasters were reported. The loss of property amounted to millions of dollars. The inhabitants of Hinckley were forewarned of the danger by dense clouds of smoke in the south, but, though forewarned, they were not forearmed, for they were powerless to stem the rush of flame, which was driven by a strong wind with irresistible fury. The flames advanced by huge leaps, and trees were twisted up in a whirlwind of fire, carried a considerable distance, and started fresh outbreaks. The scene was apalling, and flying fugitives were overtaken by the merciless element; 130 bodies were found in a space of a few acres, and were quite unrecognisable. Whole families perished, and many acts of heroism, especially on the part of the train men, were reported. The intensity of the fire may be gathered from the fact that the corduroy roads, made of logs buried many feet in the earth, were burned out by the fire working its way

under the entire width of the road. It was estimated that the area swept by the fire contained 150,000,000 feet of pine trees, the bulk of which was destroyed. Nearly all persons who passed through the fire suffered from inflamed eyes, and were obliged to wear smoked glasses. A small passenger steamer had a perilous passage of 120 miles down Thief River, skirting the Red Lake and Indian Reserve, between walls of fire. The boat caught fire several times and was quenched with difficulty. The river was so heated that it was covered with dead fish.

Algeria, about September 5th, was also the scene of immense conflagrations. The sky was obscured over an area of 60 miles. The excessive heat caused by the fires was felt as far as Tunis. The damage done was very great, chiefly around Bône. Fires broke out in many different places.

Sicily, about September 10th, suffered severely from forest fires, and vast quantities of timber were destroyed.

Denver, early in November, around Gold Hill, was the scene of fierce fires. The settlement was ruined, the houses of ranche-owners and miners were destroyed. The losses very great.

Western Texas and New Mexico, early in December, were devastated by prairie fires. Grass to the extent of 25 million acres, much stock, and many farm buildings were destroyed. Great loss.

ASTRONOMY, in 1894, presented fewer points of interest than usual.

Eclipses were four in number, but of these only a partial one of the moon was visible in this country, and that was in the early morning and occurred in dull weather.

Sunspots were numerous, and a very large one occupied the sun's disc between February 18th and 28th, which produced magnetic disturbances and fine auroræ.

Occultations.—The moon, in her majestic path through the heaveus, takes a rather wide range, and in her monthly journeys she passes over many stars, sometimes of the first magnitude, and various ones in different years. This gives much variety, interest and beauty to her frequent passages. In the past year the bright star *Spica* was twice occulted. In the current year some of the stars in the Pleiades will be so several times, also the fine star Regulus, Venus, too, will suffer obscuration, but in a bad position for observation.

Mercury.—The transit of this planet across the solar disc at 4 p.m. on November 10th was looked forward to with much interest, but the whole phenomenon lasted only a short time, and near sunset, and the opportunity, slight as it was, was marred by clouds, so we must look to more favoured localities for an account of the transit. A white spot has been observed on Mercury, which is only visible on its black surface at the time of a transit, and a further examination is desirable. It may possibly be a polar snowcap.

Mars was a conspicuous object in the evening sky in October, and in a favourable position for observation. Some bright spots were noticed near the terminator, which are probably the illuminated tops of high mountains, possibly snow-covered, thrown into strong relief by the darkness of the general surface. Observers familiar with the aspect, through the telescope, of the young moon, and the brilliant points of light seen under the oblique illumination then prevailing, will realise the appearance. The Lowell Observatory, near the town of Flagstaff, in Arizona, over 7,000 feet above the sea, was established for observing Mars in the summer of 1894. Mr. Lowell, with the means at his disposal, was able in June last to observe the gradual disappearance of the south polar snowcap, and the widening of the surrounding dark mark which the polariscope seemed to show to be clear water. The bright spots led to a renewal of the wild speculation of two years ago, and the credulous assumed that the inhabitants were signalling to attract the attention of the dwellers on earth. This point was considered in my paper of 1892, and shown to be unfounded.

The Habitability of Planets is a problem of undying interest to the thoughtful of mankind, and it naturally seems impossible that the earth alone, of all the heavenly bodies, should be inhabited; and yet science does not lend much colour to the idea that many of them contains being like men *contemporaneously* with dwellers on the earth. The large planets, Jupiter, Saturn, Uranus, and Neptune, are still in the hot stage, and not yet fit for occupation; and when they are sufficiently cooled, their enormous distance from the sun will be a difficulty to people like ourselves, and some constitutional modification in the nature of the inhabitants will be necessary. Mercury is too near the sun, but a dense atmosphere and much watery vapour might suffice to temper the fierce heat. Venus, also, is very near, but we have reason to think that she has a very dense atmosphere, which was made manifest during the transit of Venus in 1882. The earth, occupying the mean position she does, one might *a priori* expect to have inhabitants, even without our knowledge of the fact. Mars appears to resemble our earth more than the other planets, and it may be peopled, but there are many difficulties in assuming that it is. The moon is a dead satellite, and, if once tenanted, the lunarians have long since departed. The different stages of development of planetary bodies would point to the conclusion that they would not be fit for occupation at the same time, but in succession.

Then the myriads of stars we see spangling the firmament are all in a state of incandescence, some hotter than our sun, and some cooler. They are all radiating heat into space at a prodigious rate, and science points to a time, extremely distant, when they will become cold and black; that is on the assumption, inevitable in our present state of knowledge, that radiated heat is lost for ever, and cannot be returned. We must not be too sure of this, for there may be some means of conserving so much energy, of which at present we have no idea. It is

necessary to be very humble in contemplating such a mighty theme, or the great Architect of the universe may put to us the question addressed to the patriarch Job. Where wast thou when I laid the foundations of the earth, and all the other mighty works of creation? The study of the heavens will fittingly occupy the highest powers of generations yet unborn, and it is doubtful whether many ages of eternity will suffice to unravel the transcendent mysteries of the universe.

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD.

No. of Gauge on Map.....	J. A. B. Williams, Taff Fawr, No. 1 Reservoir, Brecon.				G. A. Lundie, Cwm Bargoed, Glamorgan.				W. Jones, Castell Nos Reservoir, Mardy, Rhondda, Glamorgan.			
Rain Gauge { Diameter of Funnel.....	5 inches.				5 inches.				5 inches.			
Rain Gauge { Height { Above Ground...	1 foot.				1 foot.				1 foot.			
Rain Gauge { on Top { Above Sea Level	1,328 feet.				1,237 feet approximately.				1,110 feet.			
(As levelled from Ordnance B.M.)												
1894.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which '01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which '01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which '01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	9·89	·91	27th	24	4·82	0·50	9th	16	6·26	·57	16th	21
February	12·77	1·38	10th	22	3·97	0·70	18th	13	6·80	·71	23rd	20
March	8·20	1·82	12th	15	3·54	0·70	1st	10	5·77	1·37	12th	15
April	4·15	·90	25th	20	3·50	0·55	15th	14	3·26	·57	25th	15
May	5·95	1·68	8th	19	3·09	0·70	8th	12	4·48	·74	8th	17
June	4·56	·81	4th	21	2·85	1·05	3rd	14	3·36	·73	4th	15
July	6·02	1·82	24th	26	5·54	2·00	24th	16	4·55	1·19	24th	20
August	6.06	·86	25th	25	4·26	1·00	25th	18	5·00	1·02	26th	19
September	2·20	·82	7th	7	2·24	0·53	7th	8	4·94	1·87	23rd	7
October...	9·74	2·32	26th	15	7·32	1·26	30th	13	9·23	1·68	27th	13
November	11.48	1·84	13th	21	8·05	2·24	13th	15	8·60	1·53	13th	18
December	8·41	1·56	17th	23	3.27	0·75	15th	11	5·16	·81	17th	16
Total...	89·43			238	52·45			160	67·41			196

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	GEO. PALMER, Penwyllt, Brecon.	G. A. BROWN, Tredegar, Monmouthshire.	FORSTER, BROWN & REES, Glyncorrwg, Glamorgan.
Rain Gauge: Diameter of Funnel.....	5 inches.	8 inches.	5 inches,
Rain Gauge: Height above Ground...	1 foot.	1 foot.	4 feet 6 inches.
Rain Gauge: on Top above Sea Level (As levelled from Ordnance B.M.)	1,108 feet.	1,024 feet.	717 feet.

1894.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	8·51	1·12	10th	18	8·02	·72	8th	24	10·40	1·16	16th	27
February	8·82	1·15	1st	18	6·87	1·05	17th	19	13·61	1·69	7th	22
March	6·02	1·08	12th	11	5·74	1·66	12th	12	8·69	1·95	13th	15
April	4·03	0·70	23rd	12	4·52	·77	25th	17	4·35	1·16	26th	20
May	4·99	0·94	8th	14	4·15	·92	8th	18	6·70	1·31	9th	21
June	4·60	0·68	3rd	15	3·44	1·20	3rd	15	6·16	0·94	5th	22
July	6·19	1·25	24th	20	5·31	2·06	24th	19	5·82	0·80	25th	25
August	7·59	0·81	25th	19	4·48	1·13	27th	22	8·14	1·09	26th	25
September	1·62	0·83	8th	5	2·35	·58	24th	8	2·18	0·95	8th	8
October...	8·63	1·83	30th	13	8·94	1·91	26th	14	11·33	2·58	31st	12
November	11.56	2·33	13th	20	10·12	2·54	13th	19	12·82	2·00	14th	22
December	7·85	1·41	21st	17	6·03	·94	17th	19	9·72	2·03	18th	23
Total...	80·41			182	69·97			206	99·92			242

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....			SIR W. T. LEWIS, Treherbert, Glamorgan.			JOHN CLUBSON (Gardener), Dennel, Hill, Chepstow, Gloucester.			E. J. LOWE, F.R.S., Shirenewton Hall, Monmouthshire.		
Rain Gauge	Diameter of Funnel.....		5 inches.			8 inches.			8 inches.		
	Height	Above Ground...	1 foot.			1 foot.			1 foot.		
	on Top	Above Sea Level	670 feet.			573 feet.			531 feet.		
(As levelled from Ordnance B.M.)											
1894.			Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
			Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	...	...	12·23	1·35	19th	20	3·854	·580	9th	21	4·452	0·482	29th	26
February	...	...	9·61	1·47	23rd	21	4·520	1·495	24th	20	5·637	1·430	17th	21
March	...	...	9·31	2·33	12th	12	3·155	1.050	12th	12	4·278	1·510	12th	13
April	...	...	4·59	1·02	14th	13	2·644	·630	11th	15	2·691	0·445	11th	18
May	...	...	7·02	1·70	8th	18	3·126	·580	8th	18	3·552	0·610	8th	18
June	...	...	4·85	1·54	2nd	16	1·142	·197	15th	12	2·713	0·827	3rd	18
July	...	...	5·39	1·16	24th	25	3·195	1·170	24th	14	5·969	2.210	24th	21
August	...	...	6·26	1·29	25th	22	3·285	1·130	25th	18	6·558	2.112	25th	19
September	...	...	2·20	·76	23rd	5	3·561	1·155	24th	9	3·553	1·234	24th	9
October	...	...	13·54	2·58	26th	11	5.130	·995	30th	13	5·708	1·247	30th	18
November	...	...	11.77	2·35	13th	18	4·134	1·080	13th	19	5·868	1·570	13th	20
December	...	...	8·52	1·92	17th	17	4·307	·635	13th	18	4·335	0·575	17th	23
Total	...	...	95·29	19·47		198	42·053			189	55·314			224

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	Sir W. Thos. Lewis, Mardy, Aberdare, Glamorgan.				Evan Jones, Abernant, Aberdare, Glamorgan.				Edward Curre, Itton Court, Chepstow, Monmouthshire.			
Rain Gauge { Diameter of Funnel.....	5 inches.				5 inches.				8 inches.			
Rain Gauge { Height { Above Ground...	2 feet.				5 feet 3 inches.				4 feet.			
Rain Gauge { Height { on Top { Above Sea Level	431 feet.				430 feet.				390 feet.			
(As levelled from Ordnance B.M.)												
1894.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	8·80	·99	18th	22	9·45	1·12	20th	18	4·205	·540	29th	25
February	7·94	1·15	23rd	20	8·30	1·45	27th	17	5·112	1·500	17th	21
March	7·10	2·04	12th	12	7·99	2·10	3rd	8	3·798	1·250	12th	13
April	3·97	·67	27th	13	3·75	·79	26th	13	2·750	·870	11th	16
May	4·22	·83	9th	15	3·69	·94	9th	10	3·090	·590	8th	17
June	3·21	·55	2nd	15	3·03	·85	2nd	10	2·251	·780	3rd	14
July	5·12	1·43	24th	17	4·85	1·44	25th	12	4·035	1·530	24th	19
August	3·76	·97	25th	21	4·18	·93	26th	11	3·580	1·040	25th	20
September	2·03	·52	7th	8	2·10	·69	11th	5	3·513	1·120	24th	11
October...	9·85	2·08	26th	13	9·37	2·10	27th	10	4·950	1·500	30th	17
November	10·19	2·75	13th	18	10·69	2·35	15th	16	5·736	1·510	13th	21
December	5·88	1·24	21st	19	5·85	1·39	23rd	17	3·985	·560	17th	16
Total	72·07	15·22		193	73·25	16·15		147	47·005			210

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	T. Hutchins (Gardener), Gwernyfed Park, Breconshire.				F. J. Mitchell, Llanfrechfa Grange, Monmouthshire.				Daniel Owen, Ash Hall, near Cowbridge, Glamorgan.			
Rain Guage { Diameter of Funnel.....	5 inches.				5 inches.				8 inches.			
Rain Guage { Height { Above Ground ...	1 foot.				4 feet.				1 foot.			
Rain Guage { Height { on Top { Above Sea Level (As levelled from Ordnance B. M).	350 feet.				326 feet.				315 feet.			
1894.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which .01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	3·14	0·38	30th	28	4·05	·55	9 & 15	21	3·07	·40	15th	23
February	3·50	0·88	17th	20	5·16	1·29	17th	20	3·02	·59	17th	20
March	2·36	0·60	12th	13	3·99	1·25	12th	13	3·67	·90	12th	15
April	2·27	0·42	25th	15	2·13	·33	27th	16	2·26	·33	25th	15
May	2·65	0·47	15th	17	2·71	·57	8th	14	2·68	·60	8th	15
June	1·39	0·60	3rd	15	2·59	1·13	3rd	13	2·97	·70	3rd	16
July	4·57	1·80	24th	25	4·82	2·44	24th	18	4·72	·91	24th	21
August	3·34	1·12	25th	24	4·19	1·66	25th	19	5·23	1·05	25th	19
September	2·10	0·64	7th	11	3·41	1·12	24th	10	1·97	·58	7th	9
October...	4·56	1·30	26th	19	6·34	1·19	27th	15	7.65	1·45	30th	15
November	5·46	1·25	12th	23	5·91	1·63	13th	20	6·44	·80	7th	21
December	2·90	0·38	21st	20	4·03	·51	17th	20	4·61	·62	17th	19
Total	38·24			230	49.33			199	48·29			208

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	D. Herbert Lewis, Tan-yr-allt, Ystalyfera, Glamorgan.				W. Jones, The Reservoir, Pontypridd, Glamorgan.				Henry Clay, Piercefield Park, Chepstow, Monmouthshire.			
Rain Gauge: Diameter of Funnel	8 inches.				5 inches.				5 inches.			
Rain Gauge: Height above Ground	1 foot 6 inches.				1 foot.				1 foot 6 inches.			
Rain Gauge: Height on Top above Sea Level (As levelled from Ordnance B.M.)	300 feet.				300 feet.				300 feet.			
1894.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	7·81	1·45	10th	17	6·69	·95	15th	24	3·86	·45	29th	20
February	5·83	1·45	25th	14	8·79	1·31	17th	22	4·67	1·37	17th	18
March	6·46	1·40	13th	14	6·48	1·62	12th	14	3·24	1·03	12th	12
April	2·76	·48	23rd	16	3·32	·78	24th	17	2·86	·86	11th	17
May	4·98	1·01	8th	16	3·91	·76	9th	15	2·81	·50	8th	15
June	2·08	·62	3rd	7	3·73	1·00	4th	18	2·14	·68	3rd	14
July	5·08	·92	24th	19	4·67	1·14	23rd	16	3·59	1·15	24th	21
August	5·70	·80	25th	26	4·81	1·14	25th	16	3·29	1·01	25th	19
September	1·51	·78	7th	7	2·51	·53	22nd	10	3·29	1·03	24th	9
October	8·64	1·75	26th	13	7·91	1·37	27 & 30	14	4·54	·90	30th	15
November	9·89	2·06	13th	22	8·81	1·62	13th	19	5·11	1·07	13th	17
December	5·36	1·52	17th	8	4·28	1·07	18th	14	3·85	·50	14th	17
Total	66·10			179	65·91			199	43·25			194

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map	Sir Henry Mather Jackson, Llantilio Court, Abergavenny, Monmouthshire.				Edwin C. Pole, Neath, Glamorgan.				Thos. Coomber, pro. Lord Llangattock, The Hendre, Monmouthshire.			
Rain Gauge { Diameter of Funnel.....	5 inches.				5 inches.				8 inches.			
Rain Gauge { Height Above Ground...	10 inches.				1 foot.				1 foot.			
Rain Gauge { on Top Above Sea Level	207 feet.				204 feet.				176 feet.			
(As levelled from Ordnance B.M.)												
1894.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	4·17	·37	19th	16	5·12	·71	10th	22	3·50	0·30	9th	26
February	2·40	·97	17th	8	4·88	·71	23rd	21	2·32	0·97	17th	20
March	1·81	·83	12th	7	3·44	·97	12th	13	2·11	0·92	12th	14
April	2·83	·46	11th	13	3·05	·75	25th	16	2·33	0·81	11th	17
May	3·59	·63	15th	11	3·79	·88	8th	19	2·99	0·59	15th	16
June	2·14	1·20	3rd	8	3·68	·80	3rd	18	2·08	1·10	3rd	15
July	3·58	1·63	24th	9	5·04	·97	28th	24	3·26	1·10	24th	17
August	3·63	1·50	25th	14	4·93	1·09	25th	19	3·88	1·46	25th	20
September	3·69	1·27	24th	7	1·53	·53	7th	8	3·08	1·02	24th	14
October	5·60	1·20	26th	12	7·77	2·25	30th	12	5·14	1·09	26th	22
November	5·45	1·45	13th	17	6·56	·90	13th	21	4·61	1·33	13th	22
December	2·71	·35	21st	13	4·56	·67	7th	21	2·72	0·39	7th	22
Total	41·60			125	54·35			214	38·02	11·08		225

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map..... Rain Gauge { Diameter of Funnel..... Height { Above Ground... on Top { Above Sea Level (As levelled from Ordnance B. M.)	J. A. B. Williams, Lisvane Reservoir, Glamorgan. 5 inches. 1 foot. 135 feet.				O. H. Jones, Fonmon Castle, Glamorgan. 8 inches. 1 foot 2 inches. 130 feet.				J. A. B. Williams, Cogan Pumping Station, Glamorgan. 5 inches. 1 foot. 121 feet.			
1894.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	3·20	·41	9th	24	2·88	·40	15th	21	2·90	·36	15th	24
February	4·55	1·09	17th	20	4·80	·94	17th	18	3·84	·80	17th	17
March	3·50	1·19	12th	13	3·91	·61	5th	12	3·48	·80	12th	13
April	2·08	·50	23rd	16	2·72	·37	15 & 27	15	1·74	·54	23rd	14
May	2·56	·52	15th	16	2·74	·37	13th	15	2·55	·44	15th	14
June	2·27	·63	3rd	15	3·04	·61	3rd	16	2·45	·54	3rd	14
July	3·28	1·19	24th	15	4·09	·83	24th	20	3·95	·92	24th	18
August	2·67	1·50	25th	10	6·04	1·10	25th	20	4·19	1·20	25th	18
September	1·99	·70	22nd	9	2·82	·79	23rd	9	2·05	·63	22nd	8
October...	5·59	1·15	24th	15	5·87	1·09	30th	15	4·65	·98	30th	14
November	4·73	·99	13th	20	6·30	·91	7th	21	4·82	·78	10th	18
December	3·54	·52	9th	20	5·32	·65	14th	20	3·68	·50	9th	17
Total	39·96			193	50·53			202	40·30			189

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	J. H. Canning, Aragon House, Newport, Monmouthshire.				Iltyd Nicholl, The Ham, Cowbridge, Glamorgan.				Franklen G. Evans, F.R.A.S., Llwynarthan, Castleton, Monmouthshire.			
Rain Gauge { Diameter of Funnel.....	5 inches.				8 inches.				5 inches.			
Height { Above Ground...	1 foot 6 inches.				1 foot 3 inches.				1 foot 1 inch.			
on Top { Above Sea Level	100 feet.				96 feet.				72 feet.			
(As levelled from Ordnance B.M.)												
1894.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	3·77	0·47	19th		2·37	·31	13th	27	3·21	·37	15th	25
February	5·93	1·67	17th		2·66	·52	17th	17	4·90	1·18	17th	20
March	3·98	1·25	12th		2·28	·45	12th	12	3·67	1·25	12th	15
April	2·31	·40	23rd		1·81	·32	25th	13	1·91	·40	23rd	14
May	3·46	0·54	8th		1·72	·28	13th	15	2·26	·40	8 & 15	14
June	1·14	·62	3rd		2·20	·60	3rd	17	2·35	·62	3rd	16
July	5·03	2·13	24th		3·75	·58	31st	21	5·06	1·71	24th	21
August	4·43	1·44	25th		4·43	1·16	25th	20	4·85	1·70	25th	19
September	3·55	·86	23rd		1·84	·67	7th	7	3·08	·86	23rd	10
October...	5·17	1·08	24th		4·87	1·03	30th	16	5·40	1·10	24th	17
November	6·49	1·40	13th		4·92	·79	11th	18	5·34	1·36	13th	20
December	3·85	·60	17th		4·02	·64	9th	20	3·78	·60	17th	20
Total	49·11				36·87			203	45·81	11·55		211

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	G. Evans, The Rest, Porthcawl, Glamorgan.				J. A. B. Williams, Ely Pumping Station, Glamorgan.				Castle Gardens, Cardiff, Glamorgan.			
Rain Gauge } Diameter of Funnel.....	5 inches.				8 inches.				5 inches.			
Rain Gauge } Height } Above Ground....	1 foot.				1 foot.				1 foot.			
Rain Gauge } on Top } Above Sea Level (As levelled from Ordnance B.M.)	60 feet.				53 feet.				38·36 feet.			
1894.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	3·11	·48	8th	19	3·45	·46	15th	23	3·12	·41	19th	23
February	3·08	·75	16th	19	4·06	·74	17th	21	3·53	·79	17th	21
March	2·63	·77	12th	13	4·31	1·12	12th	16	3·58	1·09	12th	14
April	2·60	·41	22nd	13	2·22	·45	23rd	17	2·19	·44	27th	16
May	3·12	·95	9th	15	2·45	·50	15th	15	2·44	·45	8th	13
June	2·45	·76	3rd	15	2·86	·72	3rd	15	2·64	·72	3rd	16
July	4·49	·86	28th	19	4·42	·93	24th	25	4·29	1·04	24th	20
August	3·94	1·01	25th	18	4·96	1·36	25th	21	4·32	1·30	25th	18
September	1·29	·42	7th	9	2·32	·91	23rd	9	2·35	·75	21st	8
October..	6·32	1·70	30th	12	5·72	1·41	24th	16	4·95	1·10	24th	16
November	5·35	·76	13th	16	5·14	·91	13th	18	4·88	·95	13th	19
December	3·62	·46	7th	19	3·94	·56	14th	19	3·50	·48	14th	24
Total	42·00			187	45·85			215	41·79			208

The Geology of Barry Island.

By F. T. HOWARD.

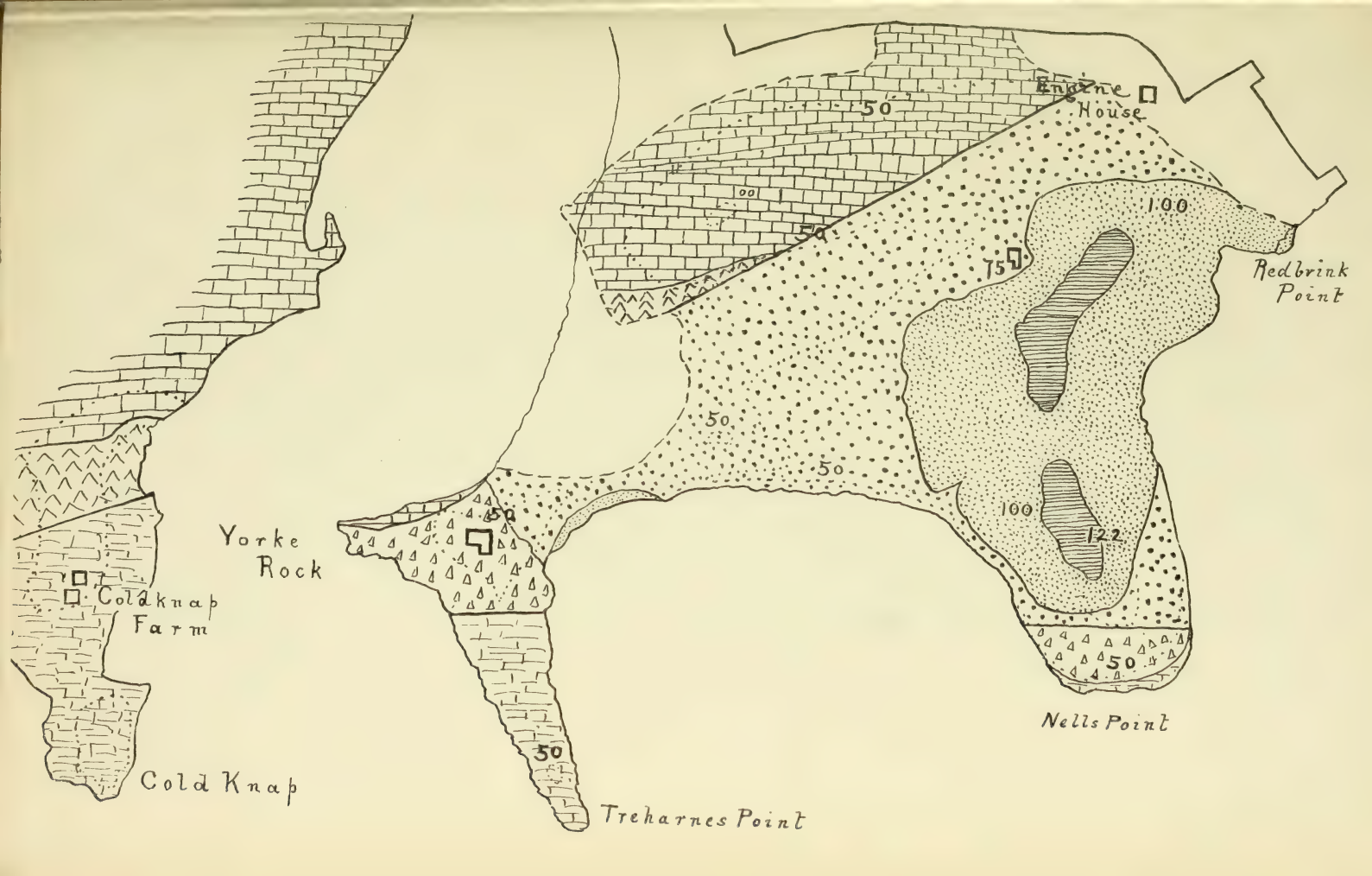
(Read before the Biological and Geological Section.)

THE Island, which is situated to the south of Barry Dock, affords so many examples of the leading features of geology, that for the past two years I have used it as a training ground for my students. The results thus obtained may have some interest for members of the Section.

Dealing with the rocks in the order of their formation, the carboniferous limestone constitutes the skeleton of the island, the framework, which in spite of the ravages of time, has held together and supported a roof of softer and more friable material.

It may still be inspected in the cliff and higher ground of Cold Knap and Treharne's Point, along the north shore behind Lord Windsor's house, and again at Nell's Point, as well as in shelves about high water mark around the greater part of the two promontories. The dip of the limestone at the fault on Cold Knap and along the north shore is 60° S. b. W.; at York Point, on the west, 55°, gradually decreasing until on the southern outcrop at Nell's Point the clinometer showed 25° S. b. W., at Treharne's Point 23°, and on Cold Knap 33° S.S.W.

I have attempted to calculate the thickness of the series, taking an average dip of 35°, or 8 in 11, which would give a vertical thickness of 1,160 feet on the east, and 1,276 feet on the west.


Engine House
50
50
100
75
Redbrink Point
50
50
50
100
122
50
Nells Point
Yorke Rock
Coldknap Farm
Cold Knap
50
Treharnes Point

In this calculation the repetition due to faults is altogether neglected, but, as far as I have observed, there are none of appreciable amount.

The importance of this estimation as a help towards a better comprehension of the physical conditions under which the limestone was deposited may be gathered from a comparison with the *full* thickness at Bristol, where it is 2,710 feet, at Llangattock 250 feet, at Caerphilly Tunnel 840 feet, and at Swansea 1,600 feet. For several reasons I am inclined to say that the beds are of lower and middle carboniferous limestone age. Taking them more in detail, the beds on the north side, that is the lowest exposed, are more impure than the upper. Two or three shale beds of about 2 feet in thickness appear near the sidings in a quarry in which the limestones are earthy and contain shale partings. Some bands weather red owing to the amount of iron contained in them, and the red oxide occasionally has collected together and filled up small cracks. Calcite is the usual vein-stuff, and is represented in the above quarry by a large vein about 2½ feet across, which shows up in a vertical face.

Some of the limestones, however, are siliceous, as may be seen in this quarry and to the west of it, and better still in the road by the farm on Cold Knap, where the chert appears in bands and concretionary patches, full of fossils, the original calcareous material of which has been entirely replaced by it. One band, especially, calls for attention—an ordinary hard grey limestone, whose surface is a mass of spirifera with an occasional productus. This bed runs for some distance along the north shore, and is succeeded by a lighter rock containing but few fossils.

From York Point to the Flagstaff a number of beds of various thickness follows, many of them rich in remains of life, especially corals. Encrinites and Brachiopoda are abundant on the weathered surface near Treharne's Point, and also on Cold Knap, where some of the Crinoid stems are more than 2½ feet in length. Productus can be found in crowds near Nell's Point. The rare occurrence of oolitic structure in these beds is very noticeable, since it is characteristic of the limestone of other parts of South Wales. Mr. Storrie, however, has among his slides of carboniferous limestone, one showing excellent oolitic structure and a number of foraminifera, from Barry Island.

A list of the fossils, unfortunately very incomplete, follows:—Retepora undata; Fenestella membranacea; Syringopora reticulata; Lithostrotion basaltiforme; Lithostrotion junceum or irregulare; Zaphrentis cylindrica; Cyathophyllum sp.; Poteriocrinus stems; Platycrinus stems, calyx and arms; Plates and spines of Echinoderms; Rhynchonella pugnus; Productus semireticulatus; Productus giganteus; Orthis resupinata; Streptorhynchus crenistria; Spirifer striata; Spirifer attenuata; Spirifer bisulcata; Loxonema sp.; Euomphalus pent angulatus; Goniatite sp.; Orthoceras sphinctus.

From the map it may be seen that the northern boundary on Cold Knap, on which the limestone rises above the 50 ft. contour, is a large

fault running W.S.W., E.N.E. On the western limit of the Island, near Lord Windsor's house, it is cut off by the brook on the north and covered to the south by newer beds, which are themselves thrown out by a small fault, E. and W. in direction, whereby the limestone comes to the surface again, reaching the 50 ft. contour line at the flagstaff. Small veins of galena penetrate the rock in every direction, and the joints are filled with crystals of calcite. Some of these veins are of large size and can be easily, and in some cases are extensively indentated by the action of the waves.

The Island is wasting faster than one would be inclined to imagine, for though little damage is done on the dip slopes where the rock can meet the storm full in the face, the side thrusts are too numerous to be warded off, and along the edges the undercutting follows the bedding planes, so that within the near future the portion south of Lord Windsor's house will be separated from the remainder of the island.

There are no representatives of the Millstone Grit and Coal Measures at Barry; and nowhere in South Wales, as far as I know, anything equivalent to the Permian or Magnesian Limestone of the North of England. The beds which lie unconformably on the Carboniferous Limestone at Barry are entirely of Mesozoic age, and when the term Magnesian Limestone is adopted it must be taken as a synonym of the Dolomitic Breccia group. This group is particularly difficult to deal with, but from evidence obtained elsewhere it is stated that the accumulation of the breccia did not commence till Upper Trias, otherwise Keuper, times. Along the flanks of the Mendips there is distinct proof that it is not a definite bed at the base of the red clay, but a continuous series of deposits of the same type formed near the shore line during the period when the red clays were being accumulated in deeper waters. There is a strong probability that the various divisions of the breccia of our own district are the shore equivalents, not only of the Keuper clays and Teagreen marls, but of the Rhaetic and Lias beds.

I wish particularly to draw your attention to this fact in order that you may avoid the error, very likely to arise from the Survey's method of colouring, of imagining that the conglomerate as a rule is older than the clays. I have similarly coloured two areas. The one on the west, near Lord Windsor's house, is cut off to the south by the fault previously mentioned. The other is on the east, near Nell's Point, where the breccia reaches the 100 feet contour, and the continuation of the same E. and W. fault forms its northern boundary. No better example of an unconformity could be found, and it has been constantly figured by De la Beche and others, and as recently as the present year by our member, Mr. Small, in his book "The Earth." The newer beds lie fairly horizontally across the edges of the limestone and fill up the irregularities of the surface, so that the difficulties of walking over a succession of sharp ridges and deep cracks are entirely removed. At the same time the thickness of the breccia is very variable, as a few sections will show.

(1).—*By second hedge from Redbrink Point.*	(2).—*East of Whitmore Bay, where sand covers the rock.*	(3).—*West side of Bay, half way towards the Point.*
Red Marl 27 feet. Green and yellow Marly Limestone Coarse Breccia } 71 feet. Carboniferous Limestone.	Green Marl ... ... 11 ft. Thick green Marl rock 7 ft. Red Marl, green bands and many concretions 21 ft. Breccia ... 1 ft. to 2ft. Carboniferous Limestone.	Fine grained light coloured Limestones Very coarse Breccia grey and green ... Coarse red and brown Breccia ... ... } 14 feet.

An excellent section for showing this irregularity is exposed between the quarry on the north side and the sidings.

The section given in the survey memoir on the district represents the usual succession, which is best seen on the west side of the island and in Whitmore Bay. The breccia is variable in character and especially in the size of the enclosed limestone fragments, some of which are 2ft. to 3ft. across. Patches of greenish marl occur in the rock in a most unaccountable way.

In none of the beds have we found any fossils save those derived from the limestones—corals, encrinites and shells occurring in large numbers, and some in a very perfect condition. Crystals of galena and calcite are also met with, derived from beds of the same age. Many small cavities in the magnesian limestone are filled entirely, or in part, with rhombohedral crystals showing curved faces and other characteristics typical of pearl spar or dolomite—a combination of magnesium and calcium carbonate.

Many of the blocks of carboniferous limestone were weathered beforehand, so that the fossils were standing out from the matrix when the blocks themselves were incorporated into the newer rock mass.

One or two patches of a fine grained breccia were found near Treharne's Point, and again to the north of it, lying horizontally near the top of the cliff as if there had been more of it, possibly covering much of the ground near the flagstaff.

The breccia evidently thins against the limestone mass on the eastern promontory, for a small quarry has recently been opened just below the 100 feet contour line in the carboniferous limestone itself. The breccia does not actually appear above the limestone at this spot, but can be seen about the same height very close to the quarry. Fossils are very abundant in the limestone here.

A section on the west coast, S.W. of the house, is worth mentioning. Carboniferous limestone dipping 47° S. b. W. is succeeded by 6 feet of breccia, the surface of which forms a ledge, from which a second cliff rises, consisting of first, 5 feet of carboniferous limestone with the same dip, covered by 4 feet of breccia which overlaps on both sides. The lower horizon of breccia is persistent and is found by the new railings though the carboniferous limestone forms the surface above. The reappearance of the limestone in the cliff might be due to a fault

running parallel to the coast, but as the same arrangement appears again on the coast of Whitmore Bay (Fig. 1) and on the east side of the island, that explanation does not suit the case.

The last named section shows :—

Red Clay ... 30 feet.
.....no Breccia.
Carboniferous limestone.
.....Ledge.
Dolomite Breccia. ... 2 feet.
Carboniferous Limestone.

I can see but one explanation for this curious succession of rocks—that the two heights really represent different periods of breccia formation—stages, when the sea level had either sunk or risen, most likely the latter.

There is only one place where the passage from breccia to red clay already mentioned may be seen—the junction near the hedge from the bay to the old brook course to the north—and I am not certain of this for a fault in that direction hidden by the new pathway which leads from the west corner of the bay up the cliff, might bring down the red clay to the same horizon. The presence of a strong spring in the corner of the bay is a point in favour of this view.

The Keuper marls cover a large part of the island and I have adopted two shades to represent the two divisions which exist—the red marls at the base and the tea-green marls above.

I doubt whether there is any value in this difference of shading. As the one bed passes into the other without any break, merely by gradual changes of colour, the line itself may be drawn incorrectly in places. I have attempted to place it where the colour becomes persistent.

The red clay forms the cliff from the engine house, (where it is brought in contact with the Lias beds by a fault—Fig. 2) along the side of the dry dock, being well developed at Redbrink Point, continues along the east coast almost to Nell's Point, and reappears on both sides of Whitmore Bay about high-water mark. Small sections can also be seen in the brooks running into the bay and along the new road from the hotel to the west.

Near the engine-house the red clay is much folded and small faults occur—some in a reverse direction. In the road from the dock to the hotel a small anticline is rendered visible by the presence of greenish bands, the persistent dip beyond being apparently W.S.W. but sinking from 12°—7°.

The greenish bands become more numerous and I have drawn the junction line N. of the 100 feet contour. Near the tunnel, under Redbrink Point, where the red marl rock is hard when first exposed but readily crumbles under the effect of the weather, the thickness cannot be under 80 feet.

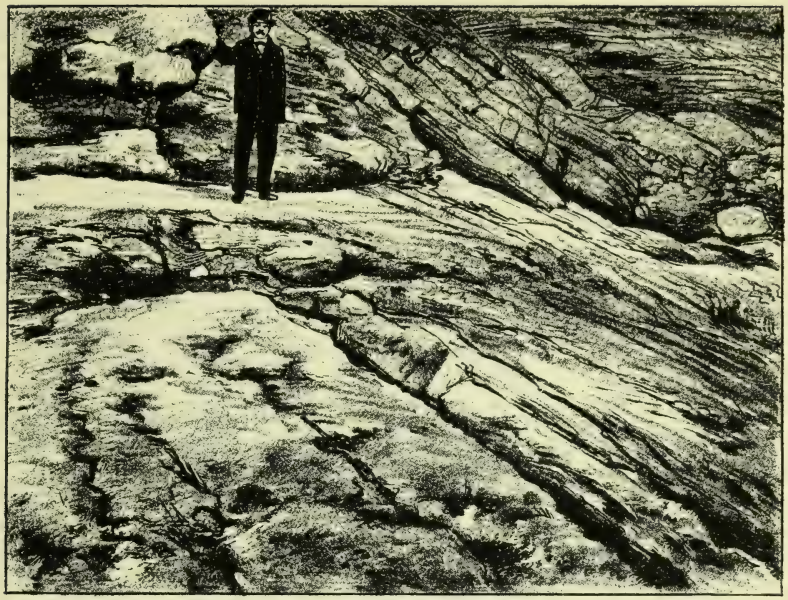


Fig.1

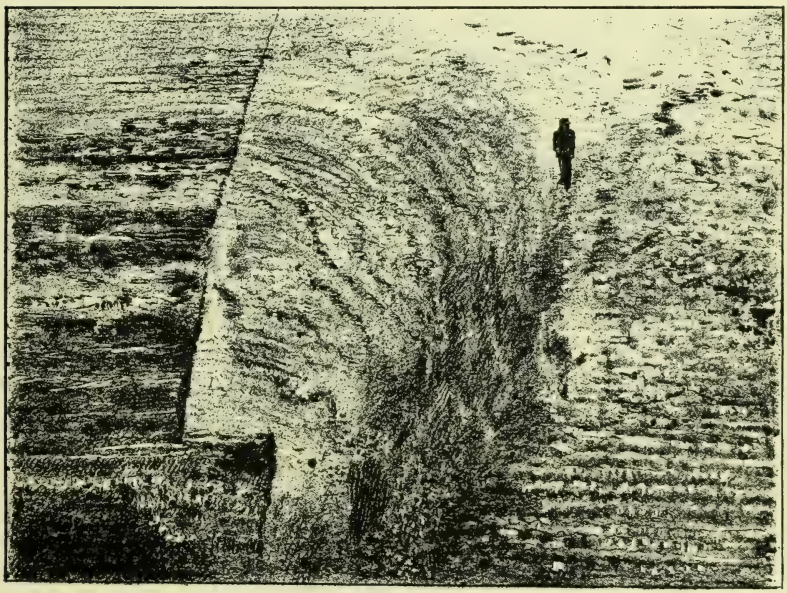


Fig.2

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Near Redbrink Point and S.W. of it the beds dip irregularly and there are two faults throwing 7 feet and 8 feet W. b. S., the beds flattening rapidly beyond.

Here, in small cavities in the red marl, there are some curious little crystals exhibiting irridescent colours. There is evidently iron oxide in small quantities about them, and analysis has proved them to be calcite, containing an appreciable quantity of magnesium and a trace of iron. The colour was probably due to solid impurities.

At the angle below the hedge a section showed—Bluish clay with red bands and harder calcite zones 24 feet at least; Red clay 2 feet; Red marl rock 3 feet; Red clay with green bands and many concretions of gypsum and calcite intermixed 19 feet; with a dip of 7° N.E. by E. The concretions are numerous and of large size, some being 1 foot across. The clay appears to be faulted down in the bay and shows similar bands of concretions which are usually small, from 3 to 6 inches across. Some are solid in the interior, others have a radiated structure and show distinct crystals which appear to be imperfect rhombohedra. They are only slightly attached and become loose on shaking. Analysis has shown them to be calcium carbonate, with magnesium, iron, and also sulphates and chlorides replacing the carbonate in part. A similar series flanks the new pathway on the west side of the bay containing many concretions, and here the red clay overlies the finer limestones of the Dolomite Breccia series.

From these beds fine crystals of baryto-celestine were obtained during the excavations in the dock. They occur in tabular rhombic prisms, having the typical blue colour, and are very brittle.

One of my students, Mr. W. John, has kindly analysed a specimen for me. His results were :—

$BaSO_4$	43·01
$SrSO_4$	56·99
	100·

The same mineral, usually in a fibrous condition, appears in thin veins in the carboniferous limestone in several small quarries along a line running E. and W. across Nell's Point, and, according to Mr. Storrie, on the Bendrick Rock.

Owing to the readiness with which they weather, the clays have plainly given rise to the curious shape of the island, especially in the case of the broad sandy bay on the south. The denudation of the bay, however, is more than balanced at the present time by the amount of sand blown inwards.

The tea-green marls call for little description. They include red clay bands, thin earthy limestones, and veins of fibrous gypsum.

A patch of ground from which the turf had been removed, and which was afterwards washed clean by water, first indicated the presence of rhaetic beds.

Upon a close examination we found a narrow ledge of earthy limestone

covered with black silvery paper shales containing obscure fossils, and this was succeeded by a hard, dark coloured crystalline limestone, from which we obtained the typical rhaetic fossils. We dug along the junction but failed to find anything like a bone bed, and I have only obtained one obscure bone fragment from the limestone. We tried, by making a series of small pits to follow out the succession, and to find the direction of the dip, but failed owing to the variable thickness of the sand. The outcrop is drawn, in the absence of more exact data, from the evidence afforded by the patches of tea-green marl rock which come here and there to the surface.

Another small section, in a road behind the hotel, showed a crystalline limestone full of fossils—Cardium Rhæticum, Pecten Valoniensis, and the rarer Placunopsis alpina.

Here, again, we hoped to get more information by digging above and below, but failed from the same cause.

The Rhaetic beds cannot be thicker here than 15 feet, and I do not think that the White Lias is represented on the island.

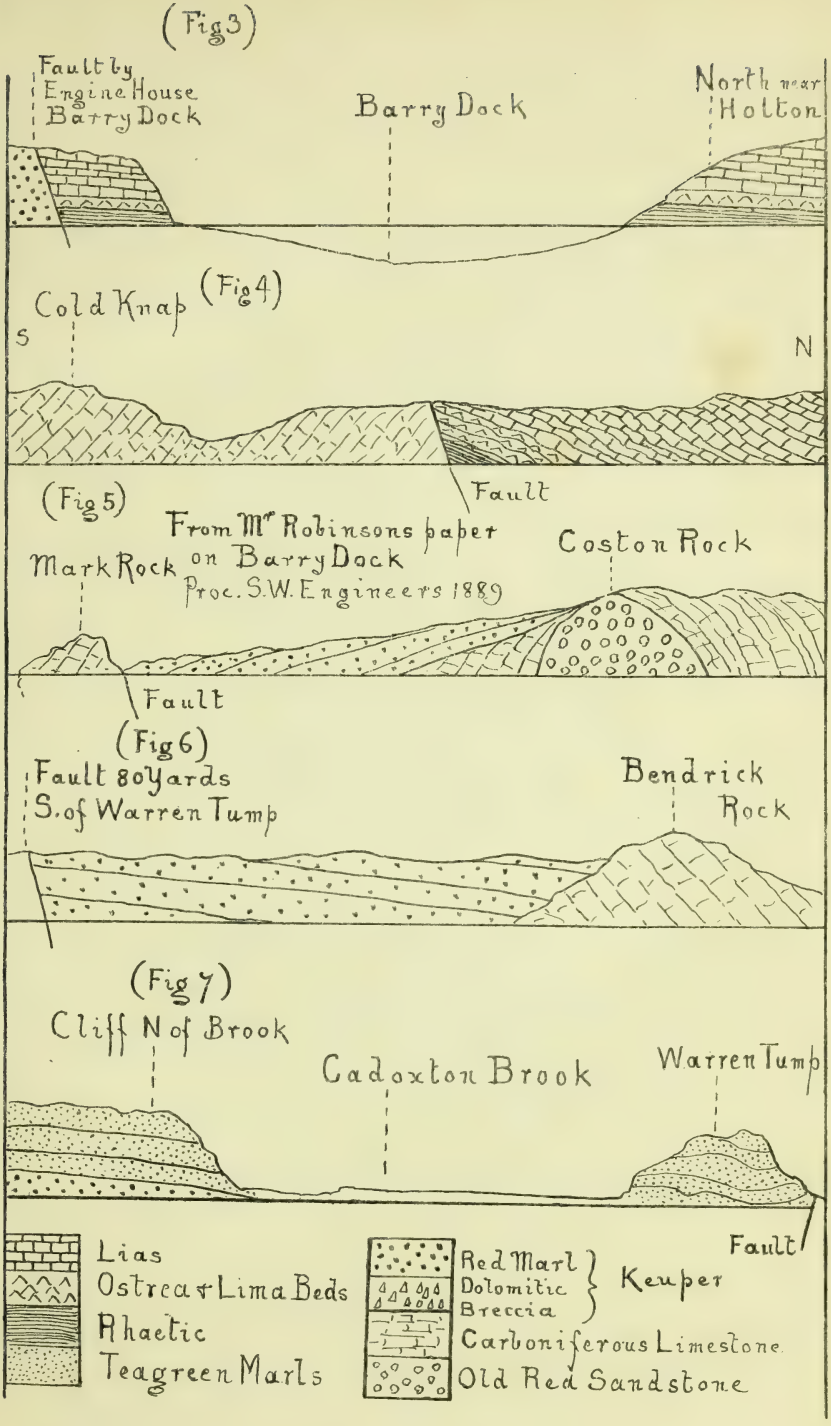
The fossils obtained from the Rhaetic beds were:—Pecten Valoniensis; Cardium Rhaeticum; Avicula contorta; Placunopsis alpina; Discina Townshendi; Axinus cloacinus; Anatina praecursa; Pleurophorus elongatus; Gervillia praecursor; Plicatula acuminata; Ostrea multicostata; Ostrea sp.; Monotis decussata; Straparollas sp.; Natica opellii.

I have already spoken of the big fault which crosses the island by the engine-house, where it is well seen in the railway section, along a line north of the Leech Pool and so across to Cold Knap.

The railway section running N.N.W. shows the fault crossing obliquely in a W.S.W.—E.N.E. direction, the red clay of the Trias standing at the same level as the beds of the lias (Figs. 2 and 3). The fault is very marked because of the amount of veinstuff worn from both rocks and extending horizontally about 6 feet.

On one horizon the fault makes a sudden bend at a right angle, probably owing to the presence of a harder calcareous band.

Roughly I should say that the throw is from 120 to 130 feet. The fault is not seen again on the island, and no evidence of its effect can be noticed on the surface. Near the sidings where the new road from the mainland was lately constructed its presence is again marked by the proximity of the outcrops of the Ostrea beds, and the red Trias clay, for the distance between is too small for the outcrops of the full thickness of the intermediate beds. By following the branch of the road on the north side of the Leech Pool it can be proved that the fault does not cross it, for the red clay can be seen right away to the old farm. I have carefully fixed the spot on the east side of Cold Knap where the fault appears in the cliff. On the west side, if it is present at all, it is entirely concealed by the storm beach. On the south side the carboniferous limestone is cropping with a high dip to the S.S.W., and on the north the Ostrea beds, and possibly the higher zones of the white Lias are in contact. I doubt whether the throw is much greater than on the north side of the island (Fig. 4).


(Fig3)
Fault by Engine House Barry Dock
Barry Dock
North near Holton
Cold Knap
(Fig4)
S
N
Fault
(Fig5)
From Mr Robinsons paper on Barry Dock Proc. S.W. Engineers 1889
Mark Rock
Coston Rock
Fault
(Fig6)
Fault 80 yards S. of Warren Tump
Bendrick Rock
(Fig7)
Cliff N of Brook
Cadoxton Brook
Warren Tump
Fault
Lias
Ostrea Lima Beds
Rhaetic
Teagreen Marls
Red Marl
Dolomitic Breccia
Keuper
Carboniferous Limestone
Old Red Sandstone

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The succession of strata which can be seen right away along the north cliff is as follows:

Zone of Ammonites: Bucklandi.
Ammonites: Planorbis.
Lima beds.
Ostrea beds.

Near the fault the Ammonite Zones, taken together, are 56 feet thick, the Lima beds 7 feet, and the lower zone 8 feet. The Ostrea beds form the base of the cliff, dipping 4° N. b. W., and consist chiefly of limestones, with some beds of clay and shale intervening. Two bands over 4 inches in thickness are extremely hard and crystalline. Some are crowded with Ostrea Liassica, together with a few Modiola minima and Limas. Following the cliff westward the beds roll slightly. Near the old lime-kiln, where, apparently, the thicker bands of the zone were especially worked they appear somewhat higher in the cliff. The dips become sharper near the bridge, and a full succession can be measured in the road, and also close by in a quarry lately opened for building purposes, on the 50 feet contour.

QUARRY NEAR BRIDGE OVER RAILWAY ON BARRY ISLAND.

Limestone		6 inches.
Black shale, with Amm: planorbis		21½ ,,
Limestone		8 ,,
Black shale		16 ,,
Limestone		7 ,,
Shale		6 ,,
Limestone		7 ,,
Clay		1½ ,,
Limestone		4 ,,
Clay		3 ,,
Limestone		9 ,,
Clay		3½ ,,
Limestone		8-9 ,,
Clay		4 ,,
Limestone		9 ,,
Clay		3½ ,,
Limestone		8½ ,,
Black shale		9 ,,
Limestone		6 ,,
Clay		1½ ,,
Limestone		5 ,,
Black shale		8 ,,
Limestone		5½ ,,
Shale		1½ ,,
Limestone		5 ,,
Shale		1½ ,,
Limestone		6½ ,,
Shale		7 ,,
Limestone		1½ ,,
Shale		2½ ,,
Limestone		2 ,,
Shale		6½ ,,
Limestone		8 inches.
Shale		3 ,,
Limestone		3 ,,
Shale		9 ,,
Limestone		7 ,,
Clay		2 ,,
Limestone		6 ,,
Clay		2 ,,
Limestone		3½ ,,
Clay		2 ,,
Limestone		4 ,,
Clay		1 ,,
Limestone		2½ ,,
Clay		2 ,,
Limestone		3 ,,
Clay		2½ ,,
Limestone		2½ ,,
Clay		½ ,,
Limestone		2½ ,,
Clay		4½ ,,
Ostrea beds. Limestone		11 ,,
Clay		2½ ,,
Limestone		7½ ,,
Clay		1 ,,
Limestone		1½ ,,
Clay		1 ,,
Limestone		1½ ,,
Limestone		2 ,,
Clay		½ ,,
Limestone		2 ,,
Clay		½ ,,
Limestone		2 ,,

They appear in contact with the carboniferous limestone on Cold Knap, both beds being very crystalline (Fig. 4). The carboniferous limestone dips from 45°-60° S.S.W., and the Ostrea beds, at a lower angle, to the N. The effect of the strain was sufficient to throw the beds into a series of sharp folds, a section for a distance of 8 yards near the fault showing two anticlines and their accompanying synclines. The Ostrea beds continue to form ledges on the beach and the lower part of the cliff as far as the railway station.

The Lima beds succeed the above conformably, and shales and earthy limestones are more abundant than elsewhere on the island. One or two bands of limestone are full of species of Lima, and Ostrea still persists. As a zone, however, it is not so distinctly marked as the Ostrea group, and the limit vertically was fixed by the incoming of Ammonites planorbis. The outcrop of the Planorbis zone follows that of the Lima beds, and the best places to examine it are (1) near the engine-house, (2) in the quarry and road section near the railway bridge, (3) in a quarry by the cliff close to the Ship Inn. In the quarry, a bed of black shale, 21 inches thick, followed by a thin band of limestone, forms the roof, and from these we obtained the typical fossils in large numbers. Here, as at Lavernock, the surface of the shales was crowded with Ammonites planorbis and its near relation Ammonites johnstoni. In the road, the same shales and limestone appear, followed by a second shale bed, 13 inches thick, full of ammonites, and is, in its turn, followed by alternating shales and limestones, the latter being yellowish or creamy externally, but bluish on the inside. These limestones do not contain many fossils, and I have been unable to fix the vertical range of Ammonites planorbis. Roughly speaking, it cannot be much greater than at Lavernock, where the zone is 8 feet thick.

Above the Planorbis zone are the Bucklandi beds which probably cover the whole of the ground north of the fault, with the exception of the outcrop of lower zones at the north-west corner. The same alternation of strata prevails, and nowhere do we get the full thickness of the beds. Near the railway bridge, and again near the engine-house, they reach a thickness of at least 40 feet.

It is impossible to follow the succession in the road owing to repetition and the crushing produced by small faults, and the cliff close by which overlooks the railway is much obscured by rainwash and coal dust.

One bed served as a horizon from which we could observe and compare others as it can be readily recognised by the fantastic shapes resulting from underground weathering. The limestones were evidently charged with water, which was oozing out along the shale outcrops.

The fossils in these beds, though not particularly abundant, (with the exception of Lima gigantea) are characteristic enough, and among them I have recognised the following:—Ammonites planorbis zone—Ammonites Johnstoni ; Ostrea Liassica ; small Lima gigantea. Ammonites Bucklandi zone—Ammonites Bucklandi ; Ammonites angulatus ; Rhynchonella variabilis ; Gryphaea arcuata ; Lima gigantea ; Lima Hermannii ; Lima pectinoides ; Cardinia Listeri ; Cardinia

ovalis ; Nautilus striatus ; Pinna Hartwelli ; Unicardium cardioides ; Pholadomya ambigua ; Pholadomya aequalis ; Ostrea Liassica ; Ostrea sp. ; Avicula inaequivalvis ; Crenatula ventricosa ? Similar beds, containing Ammonites Bucklandi and Angulatus, form the surface near the Ship Inn.

VERTICAL SECTION OF CLIFF NEAR SHIP INN, BARRY.

Two nodular limestones, clay partings	11—12 inches
Clay, concretions of limestone	10 ,,
Well-jointed limestone	6 ,,
Blue shales	8 ,,
Flaggy limestone	3½ ,,
Blue shales	12 ,,
Blue-hearted limestone	5½ ,,
Hard laminated shale	10 ,,
Nodular limestone...	3 ,,
Hard blue calcareous shale	13 ,,
Hard limestone	7 ,,
Hard blue coarsely bedded shale	17 ,,
Planky limestone	2½ ,,
Shale	4 ,,
Limestone	6 ,,
Shale with nodular limestone 3½ inches...	8 ,,
Earthy limestone, Lima abundant	6 ,,
Hard thickly-bedded calcareous shale	5 ,,
Limestone of variable thickness	...2—3 ,,
Shale	4½ ,,
Persistent hard limestone...	6 ,,
Paper shales, Ammonites planorbis	10 ,,
Limestone and shaly partings	8—11 ,,
Blue shales, Ammonites planorbis	9—10 ,,
Earthy limestones	6½ ,,
Three nodular limestones and shale partings	23 ,,
Shale	13—16 ,,
Hard nodular limestone, shale parting	11 ,,
Paper shales	4 ,,
Limestone	3½ ,,
Paper shales, many ostrea	7½ ,,
Limestone	4 ,,
Shale	3½ ,,
Earthy thin shales, many ostrea	4 ,,
Limestone	9 ,,

I have throughout ignored the outcrop of the recent accumulation of wind-worn sand. There would have been little else to colour had I adopted a shading for this rock, and I should have been greatly puzzled to know where to draw the lines on the surface. There is very little of it west of the short hedge from bay to bay, but it has reached a great thickness across the bay itself. In the same way the surface of the ground north of the fault is almost free from it, but unless great care is taken one is apt to be deceived by the ridges. Certain mounds which at first sight appeared to belong rather to the domain of the archæologist than to the geologist, proved, when the spade was called into use, to be only heaps of sand. A long ridge runs from the bay towards the farm, and from this the sand spreads northwards, most

likely assisting greatly in filling up what was formerly the Leech Pool. One or two pits have been opened therein, proving it to be more than 10 feet in depth. Between this and a smaller ridge to the south the sand has been removed by rain action. Another patch spreads from the bay near Redbrink Point over the site of the old monastery and caps the high ground behind the hotel. Digging over this patch, in the hope of finding Rhaetic strata, we frequently found loose sand to a depth of 3 feet. The sand may be derived from the outcrop of the millstone grit, which should crop at no great distance from the shore beneath the channel, or, as is more likely, from the recent deposits of the Cadoxton brook.

It is necessary to mention the relation of the rocks of the island to the exposures near and on the mainland. There can scarcely be a doubt that the carboniferous limestones of Barry and Cold Knap had once a continuous crop, and the similarity of the strata near the station and on the island opposite, continuing so towards the east, would lead to the conclusion that they have once been connected. On the east side however there are evidently points of difference. The Survey authorities indicate that the fault continues N.N.E., and an island of carboniferous limestone is shown on the map. Similar patches of the limestone appear near the entrance at the Mark Rock and at Bendrick Rock. But between the two, as may be seen in the excavations made for the formation of the deep-water entrance, are whitish sandstones, red micaceous sandstones and shales, which belong unmistakably to the Old Red Sandstone group, and should form an anticlinal ridge running roughly E. and W. (Fig. 5). It is possible that such beds might be brought in by a fault, but I am disposed to think that the anticlinal of which we see part in the persistent southerly dip of the limestone on the island and on Cold Knap, rises steadily towards the east, and so brings lower beds into view.

The Mark Rock, itself, was very red and crystalline, composed of encrinites and other fossils, and Mr. Storrie informs me that the limestones pass down conformably into the reddish shales, and finally into unmistakeable Old Red beds. The dip of the limestone is about 80° S., and of the patch to the N. 32°—45° in the opposite direction. I am indebted to the same authority for the following section :—

NORTH.—Hard limestone, very red, crystalline and encrinital, and other fossils. Dip N. 32°	70—80 feet.
Reddish shaly beds (Passage Beds) dip N. 32°	
Reddish fine-grained thin bed of O.R.S.	
Red micaceous shale	8 ,,
Red sandy clayey bed, rather irregular dip, about 28° ...	about 4 ,,
Very micaceous fissile sandstone	6 ,,
Very hard siliceous sandstone	2 ,,
Micaceous flaggy sandstone	4 ,,
Fine-grained micaceous sandstone	4 ,,
Coarser-grained micaceous sandstone	6 ,,
Flaggy micaceous sandstone	5 ,,
Fine-grained hard sandstone	5 ,,
Fine-grained hard sandstone	4 ,,

The above are red in colour, those below are whitish green or brown.

Very dense pale-coloured sandstone	1 foot.
Very dense white sandstone with purple patches	4 feet.
Coarse grey and micaceous sandstone	4 ,,
Very white fine-grained and rather soft sandstone...	1 ,,
Very white hard sandstone	2 ,,
Very hard greenish white bed	2 ,,
Very hard sandstone with reddish tinge	8 ,,
Hard greyish sandstone	8 ,,
Brown micaceous sandstone	4 ,,
Grey micaceous sandstone	4 ,,
Red marl, almost horizontal	

All south of this is covered with loose sand.

The red sandstone was evidently exposed during Triassic times, for the newer sandstones of that period lie unconformably over the outcrop edges, as they do on the carboniferous limestone of the island (Fig. 6).

The fault must cross near Warren Tump, and the beds are much folded and faulted there. A group of small reversed faults is very noticeable. Here the beds appear to be tea green marls, with harder calcareous zones intercalated, as well as an earthy sandstone. Higher in the series are black shales, very like those of the Rhaetic, and I found in patches, at water level, harder beds with Rhaetic fossils. There can be no reasonable doubt that there was a connection on this side from Keuper times.

The history of the island is a long and varied one, and would take another paper if I should follow it through every stage.

Let me give a brief outline, from the time when the rocks of carboniferous and greater age had been thrown into a series of folds, east and west, the greatest being the coal basin as we know it to-day. Throughout the ages when Europe was dotted over with a series of lakes, and the climatic conditions were gradually becoming more like those which prevail in Abyssinia to-day, our country was a mountainous upland, from which streams were constantly removing large quantities of denuded material, and, at the same time, excavating larger and more open valleys in places where the rocks were softer and more yielding. It was then, probably, that the Severn river excavated its valley, but it should be noted that there is some evidence pointing to the existence of a stream running to the east or north east.

You may reasonably imagine to yourselves an open plain flanked by limestone cliffs and mountain torrents rushing through deep valleys and gorges. Some of these rivers ran along the lines between Bendrick Rock and Nell's Point—between Nell's Point and Treharne's Point, and between the latter and Cold Knap. A change in the physical conditions follows. The land sank slowly, and the broad valleys became arms of the sea, while creeks and inlets appeared where formerly tributary streams had their courses.

From the evidence afforded by our succession we can follow the change. Ledge after ledge, rising upwards, marks the stages of the

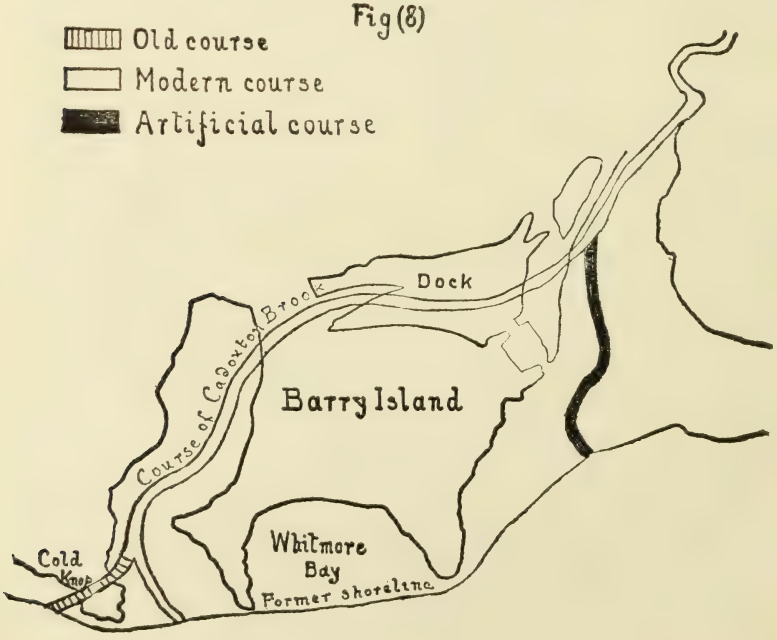
disappearance of the limestone beneath the waters, and the debris forming near the cliffs still remains to indicate the position of the ancient shore lines. In the deeper water between, where the rivers had formerly run, the finer material was being deposited, so that the thickest series of clay should be near the deep-water entrance, in Whitmore Bay and east of Cold Knap.

The subsidence continued until all the limestone islands and promontories disappeared and the red clay formed a covering over the whole. It must have been a dreary place. Scarcely an animal, save the great Labyrinthodont and Dinosaur, has left us traces of its existence on land, and the water seems to have been too highly charged with salts of magnesium, sodium, and iron for even the hardiest of molluscs to exist in it.

Again the scene changes. The same bays and gulfs are crowded with a varied fauna, and on the land we have evidence of a rich vegetation covering the former barren and sandy waste.

It is more than probable that throughout the Rhaetic and Lower Lias periods the subsidence continued steadily, and the land areas coast line retreated to the north. How long the downward movement remained unchecked, and for what period the Barry area was under water, we cannot say. Our record ends with the top of the Lower Lias. The upheaval, if we must judge by comparison with other regions, took

Fig (8)



place in Upper Jurassic times, increasing the folding which had been produced at the end of the carboniferous period. The old channels were no longer available, and new streams were formed, one of which was the Cadoxton Brook, flowing westward along a plain of the newly deposited strata. Where it entered the sea, or joined the ancient representative of the Severn, I cannot say, but I believe it was west of Cold Knap. Gradually a fairly deep valley was formed, cutting its way through the Lias and Rhaetic beds, and even through part of the hard limestone of Cold Knap. As time went on tributary streams marked the outcrops of the softer strata, and, coming nearer to historic times, the encroachments of the sea assisted in the removal of the fine clays and shales of the Trias and Rhaetic. In this way (Fig. 8) the older channel between Cold Knap and Barry was again laid bare, and the stream, once more diverted by the forces of nature, remained until by human agencies it was made to flow along another of the older courses between the Bendrick Rock and the island.

The Botanical Garden, Roath Park.

By W. W. PETTIGREW.

(Read before the Biological and Geological Section on December 20th.)

NO doubt it will appear to many as being rather premature to attempt to give a history of a botanical garden which is as yet only in embryo, or at most in its very infantcy. My reason for doing so thus early, is simply to make a record of its progress since its inception up to the present time, and I do so the more readily as the Botanical Garden of Roath Park owes its origin almost entirely to the efforts of the members of the Naturalists' Society; and its history must therefore be of deep interest to all connected with the Society.

Notwithstanding the number of naturalists, educationists and plant-lovers in Cardiff, no botanical garden existed in this town prior to the one formed at Roath Park. Ten or twelve years ago the Committee of this Society petitioned the late Mr. J. S. Corbett to have metallic labels, bearing the botanical names, attached to the trees and shrubs in the Sophia Gardens. This request was granted, and the naming and labelling of the trees was carried out under my father's supervision. Unfortunately there were no caretakers to look after these gardens, and the Cardiff youths, unused to botanical names, thought the labels were placed there for their especial amusement, and soon showed their appreciation by destroying every label in the gardens.

A few years later—in 1888—when the laying out of the Roath Park was under discussion, a deputation, consisting of Messrs. Sonley Johnston, T. H. Thomas, E. Seward, Ivor James, John Storrie, A. Pettigrew, Professor Parker, and Drs. Vachell and Sheen, waited upon the Town Council (at the request of the Naturalist Society), urging that a portion of the Park be set aside for a botanical garden. The late Mr. Peter Price—who took as active an interest in this as in all other matters connected with this Society—introduced the deputation.

As a result of the representations made by the gentlemen mentioned, the Parks' Committee decided, upon the recommendation of the Borough Engineer (Mr. W. Harpur), to allot the portion of the Park lying between the Taff Vale Railway and the lake embankment—an area of 15 acres—for a botanical garden. Although this was the most suitable portion of the whole Park for the purpose, the greater part of it was nothing but a morass, until the contractor, who was making the roads around the Park, tipped his surplus clay and soil in the worst parts of it.

Nothing was done in the way of laying out this ground as a botanical garden until the summer of 1893, when a staff of workmen was put on to drain the ground, form flood banks around the brook, and level the clay and soil just alluded to.

In laying out the ground, the Kew system of parallelogram beds was adopted in which to represent the different natural orders of hardy herbaceous plants. These beds, which are generally about 20 feet long by 7 feet wide, are easily examined by students, and are better to plant than small geometrical beds.

When arranging these the most suitable site at my disposal was selected, and as this happened to be on the made up ground, they had to be excavated to a depth of 2 feet, and refilled with good soil. To see the herbaceous ground now one would scarcely believe that it is formed on a bank of clay excavated from the public road around the Park.

After making the main walks and forming the beds as described, I asked for further instructions from my committee as to the extent to which they wished me to carry out the idea of a botanical garden, and was requested to draw up a report on the matter.

This I did, and suggested that a collection of hardy herbaceous plants should be obtained and arranged in their natural order; also a collection of hardy ferns, aquatic and medicinal plants, grasses, and as many trees and shrubs as could be conveniently represented on the area of ground set apart for the purpose. Also that every different species of plant tree and shrub, should have a label with its generic and specific name legibly written upon it and placed in such a position that anyone desirous of knowing the name could readily ascertain it.

These recommendations were adopted. The committee at the same time expressed a desire that this garden should be made worthy of the town, and voted a sum of £200 for the purpose of beginning a collection of the different classes of plants mentioned.

In the formation of the Botanical Garden in two instances the peculiarities of the ground were turned to good account. On the west side of the brook, near the lake embankment, I came upon a wide hedge-bank, which was entirely made up of sandy peat. This was formed into a peat-border, and planted with Rhododendrons, Azaleas, and other ericaceous plants. Again on the east side of the brook, at the bottom of the Fair Oak Hill, the presence of a strong spring of water made a large area an impassible marsh. A portion of this was ultimately turned into an aquatic bed by forming a puddle bank around the spring,

and introducing an overflow pipe to take the surplus water into the brook Although this is a very small bed, it is large enough for a choice collection of aquatic plants, and is far better for the purpose than the unsightly artificial brick tanks one sees in so many botanical gardens.

The fernery is as yet perhaps the least satisfactory as regards the supply of natural requirements of ferns, for its position is such that the plants have the full glare of the sun on them all day. I consider the sheltered portion of the hill on the eastern side of the garden as the most natural site for a fernery, but as we are scarcely prepared to lay this out suitably at the present time, I have had the collection of ferns planted on the small rockery running parallel with the peat border. The rock used is mostly a kind of red sandstone, which was excavated a few yards from where it now stands. To shelter the ferns as much as possible, the back—on the west side—is planted with conifers, and as a number of trees are planted at the back of the peat-border—east of the rockery—the ferns, by-and-by, will also be protected from the rays of the morning sun.

As the laying out of the Botanic Gardens was not completed until well on in the spring of the present year, I was unable to obtain anything like a satisfactory collection of trees, shrubs, or herbaceous plants for showing this season. Next year will see greater progress in this respect, as I shall have more time to devote to that portion of my duties, and the time for collecting them is much greater.

Notwithstanding that no planting was done until this spring, no less than 350 different species of plants were growing in the herbaceous beds this summer. In the rockery we have already 120 different species and varieties of hardy ferns, besides a large collection of hybrid ferns raised by Mr. Low, of Chepstow. In the peat border we have over 60 different species of Ericaceous and other plants. In the aquatic bed there are 20 different species, and the number of trees and shrubs now exceeds 70. This is not a bad record for the first six months of this garden's existence. I should mention, that I am not keeping the various genera of the trees and shrubs together, as is usually done in an arboretum, as it is not possible in the small area at our disposal to plant sufficient numbers of the same genus to justify this style of planting. With the herbaceous plants I have adopted the usual method of keeping the different natural orders by themselves, and have followed Hooker and Bertham's Genera Plantarum as nearly as possible for the sequence of the natural orders and genera, and I have, also, for the present adopted the nomenclature of these two botanists.

As 350 different species of plants would have necessarily made a very poor show in beds 20 feet long, the empty beds had to be utilized for showy florists flowers, and the result gave general satisfaction. In fact, many people are under the impression that the large number of beds are laid out for the purpose of making some such display every year, and no doubt their disappointment will be great as they find year by year the display of florists flowers diminishes as our collection of

permanent plants increases. Florests flowers will, however, always receive attention even in the Botanical portion of the Park, as they are not only very ornamental, but illustrate the process of evolution in a way which will always make them useful and instructive subjects to students of botany. A border, about 100 yards long and 9 feet wide, on the west side of the herbaceous beds has been formed specially for this class of plants, and, probably in time a few beds on the east side of the garden will be devoted to their culture.

No collection of medicinal plants has as yet been formed, but, if possible, a beginning will be made during the coming spring. I have written to several Botanic Gardens asking for assistance in this direction, and have received several promises. The medicinal plants will be grown in small beds on a triangular piece of ground lying beyond the fernery, and their classification will be carried out on the natural system, as in the case of the general collection of herbaceous plants.

The following is a list of the trees at present growing in the Botanic Gardens :—

Abies albertiana ; Abies nordmaniana ; Abies pectinata ; Ailantus glandulosa ; Aucuba japonica ; Aucuba macrophylla ; Aucuba himalayica ; Arbutus unedo ; Amorpha fruticosa ; Aralia spinosa ; Berberis aquifolium ; Berberis Darwinii ; Berberis nepalensis ; Berberis stenophylla ; Berberis vulgaris ; Berberis Wallichiana ; Caragana arborescens ; Carpinus Betulus ; Caryopteris mastacanthus ; Catalpa bignonioides ; Cedrus atlantica ; Cedrus Deodara ; Cedrus libanii ; Cephalotaxus drupacea ; Cephalotaxus Fortunei ; Chamaecyparis Lawsoniana (several varieties) ; Chamaecyparis nutkaënsis ; Chamaecyparis obtusa ; Chamaecyparis squarrosa ; Chimonanthus fragrans ; Chimonanthus fragrans var. grandiflora ; Chionanthus virginicus ; Corchorus japonica ; Cornus Kousa ; Cornus mas ; Cornus sanguinea ; Cotoneaster affinis ; Duphne mezerum ; Dentzia crenata ; Elaegnus japonica ; Embothrium coceineum ; Eriobotrya japonica ; Exochorda grandiflora ; Fontanesia phillyræoides ; Fabiana imbricata ; Forsythia suspensa ; Forsythia viridissima ; Ginko biloba ; Hymenanthera crassifolia ; Laburnum vulgare ; Liquidambar styraciflua ; Liriodendron tulipifera ; Magnolia acuminata ; Morus nigra ; Paulownia imperialis ; Pinus austriaca ; Pinus Cembra ; Pinus excelsa ; Pinus Larico ; Pinus monticola ; Pinus parviflora ; Pinus Strobus ; Populus alba ; Populus alba bolleana ; Populus balsanifera ; Populus nigra ; Populus nigra pyramidalis ; Prunus amygdalis ; Pseudotsuga Douglasii ; Quercus cerris ; Quercus coccinea ; Quercus glandulifera ; Quercus latifolia ; Quercus macrocarpa ; Quercus Merbeckii ; Rhus glabra ; Rhus typhina ; Sequoia gigantea ; Sequoia sempervirens ; Sophora japonica ; Sophora tetraptera ; Texus baccata.

The peat border contains some very interesting plants, among which the following are perhaps the most deserving of notice :—Andromeda

NOTE.—Since the above paper was read several of the trees and shrubs enumerated have been killed by the severe weather experienced during the past winter.

polifolia ; Andromeda polifolia anguetifolia ; Andromeda tetragona ; Andromeda japonica ; Andromeda floribunda ; Bryanthus erectus ; Clethra alnifolia ; Cussardra calyculata ; Erica carnea ; Erica scoticanum ; Erica stricta ; Erica allportii ; Erica Scoparia ; Erica tetralix ; Erica arborea ; Erica vagans ; Erica vagans alba ; Empetrium nigrum ; Empetrium tomentosum ; Eepigaea repens ; Gaultheria shallon ; Gaultheria acutifolia ; Gaultheria procumbens ; Kalmia latifolia ; Kalmia glauca ; Kalmia angustifolia ; Ledum latifolium ; Leucothe axillaris ; Pernettyas in var ; Rhodora canadense ; Ruscus hypoglossum ; Vaccinum vitus-idæa ; Zenobia speciosa ; Zenobia dealbata.

In the acquatic bed the following plants flowered during the summer and autumn :—Villarsia lacunosa ; Villarsia nymphaeoides ; Caltha palustris ; Lobelia dortmanni ; Ranmculus hetrophyllus ; Sparganium ramosum ; Cyperus longus ; and Aponegetum distrachyon.

Two plants of the last species, growing in this bed, have a rather interesting history attached to them. They were obtained this summer from a loch far up in the Perthshire Highlands, where they, with thousands more, were luxuriating as if they were in their own native habitat. Two or three plants were put into this loch about 40 years ago, as an experiment, by a gardener of the late Duke of Athol, with the result that they have overrun the whole loch, and the sight in the early summer may be better imagined than described.

The following is a list of the herbaceous plants grown in the Botanic Gardens last season :—

Acæna microphylla ; Acanthus mollis ; Acanthus latifolius ; Achillea clavennæ ; Achillea millefolium ; Achillea ptarmica ; Achillea tomentosa ; Achillea umbellata ; Achillea serrata ; Achillea mongolica ; Achillea Ageratum ; Aciphylla Colensoi ; Aciphylla Lyalli ; Aconitum napellus ; Aconitum anthora ; Aconitum autumnale ; Actœa spicata fructo rubro ; Adenophora Lamarckiana ; Adonis vernalis ; Adonis pyrenaica ; Agrimonia Eupatoria ; Agrimonia odorata ; Agrostemma flos jovis ; Ajuga reptans ; Alchemilla arvensis ; Alchemilla vulgaris ; Aletris farinosa ; Alstrœmeria aurea ; Alstrœmeria chilensis ; Alstrœmeria psittacina ; Alyssum saxatile ; Allium flavum ; Allium azurcum ; Allium ampeloprasum ; Anchusa italica ; Androsace sarmentosa ; Androsace lactiflora ; Anemone alpina ; Anemone decapetala ; Anemone Japonica ; Anemone narcissiflora ; Anemone nemorosa ; Anemone palmata ; Anemone pulsatilla ; Anemone sylvestris ; Anemone vernalis ; Anenome pratensis ; Anemone coronaria ; Anemone multifida ; Anemone virginica ; Anthemis cotula ; Artemesia absinthum ; Armeria maritima ; Arabis androsace ; Arenaria purpurascens ; Aronicum scorpioides ; Aquilega chrysantha ; Aquilega cœrulea ; Aquilega glandulosa ; Asclepias incarnata ; Asclepias tuberosa ; Asperula azurea ; Asphodelus albus ; Asphodelus luteus ; Aster multiflorus ; Aster lœvis var-lœvigatus ; Aster Amellus ; Aster puniceus ; Aster grandiflorus ; Aster longifolius ; Aster novœ-angliœ ; Aster sericus ; Aster turbinellus ; Aster versicolor ; Astilbe rivularis ;

Astragalus glycyphylus ; Aubrietia Leichtlini ; Baptisia australis ; Bousangaultea basseloides ; Barbarea vulgaris ; Bartsia odontites ; Bœsia gracilis ; Bœsia chrysostonia ; Bahia lanata ; Blumenbachia insignis ; Brachyrome iberidifolia ; Bidens tripartita ; Buphthalmum salicifolium ; Callirhoe involucrata ; Callirhoe linearioloba ; Calandrina pilosiuscula ; Calandrina glauca ; Campanula abietina ; Campanula alliariœfolia ; Campanula carpatica ; Campanula grandiflora ; Campanula grandis ; Campanula Hendersoni ; Campanula persicifolia ; Campanula pulla ; Campanula primulœfolia ; Campanula rapunculoides ; Campanula rottundifolia ; Campanula trachelium ; Carum Carvi ; Cardamine pratense ; Cardamine trifoliata ; Carthamnus tinctorus ; Catananche cœrulea ; Centaurea dealbata ; Centaurea macroocephala ; Centaurea montana ; Centranthus ruber ; Cerastium frigidum ; Cerinthe maculata-var.-auriculata ; Charieis heterophylla ; Chelone Lyoni ; Chelone glabra ; Chrysanthemum maximum ; Chrysanthemum carinatum ; Chrysanthemum viscosum ; Chrysanthemum coronarium ; Chrysobactron Hookerii ; Codonopsis ovata ; Correopsis lanceolata ; Correopsis verticilata ; Cortusa matthiola ; Corydalis nobilis ; Corydalis Scoulerii ; Delphinum grandiflorum ; Delphinum cardiopetalum ; Delphinum Agacis ; Delphinum cardinale ; Delphinum cashmerianum ; Dianthus cœsius ; Dianthus cruentus ; Dictamnus albus ; Digitalis ambigua ; Digitalis purpurea ; Dipsacus sylvestris ; Diplotaxus muralis ; Dielytra eximea ; Dielytra formosa ; Doronicum caucasicum ; Doronicum clusii ; Dodecatheon meadia ; Dracocephalum Ruprechti ; Dracocephalum virginicum ; Echinacea purpurea ; Echinops bannaticus ; Echinops ritro ; Echinops ruthuricus ; Echinops sphœrocephalus ; Epilobium angustifolium ; Epilobium hirsutum ; Epilobium rosmarinifolium ; Epimedinm macranthum ; Epimedium violaceum ; Epimedium versicolor ; Eranthis hyemalis ; Erigeron aurantiacus ; Erigeron grandiflorum ; Erigeron pulchellus ; Erigeron salsuginosus ; Erodium macradenium ; Erodium manescavi ; Erodium sanguineum ; Eryngium amethystinum * ; Eryngium Bourgatii ; Eryngium bromeliæfolium * ; Eryngium giganteum ; Euphorbia lathroides ; Ferula communis ; Fragaria vesca ; Galega officinalis ; Galega officinalis alba ; Genista tinctoria ; Gentiana acaulis ; Gentiana andrewsii ; Gentiana asclepiadea ; Gentiana cruciata ; Gentiana calycosa ; Gentiana decumbens ; Gentiana lutea ; Gentiana pneumonantha ; Gentiana septemfida ; Gentiana verna ; Geranium armenium ; Geranium Endresii ; Geranium ibericum ; Geranium sanguineum ; Geum urbanum ; Geum montanum ; Geum miniatum ; Gillenia trifoliata ; Gnaphalium triviale ; Gypsophila paniculata ; Gypsophila prostrata ; Gypsophila repens ; Glaux maritima ; Helenium autumnale ; Helenium Bolanderii ; Helenium pumilum ; Helianthella quinquenervis ; Hemerocallis distacha ; Hemerocallis Dumortieri ; Hemerocallis Middendorfiana ; Hemerocallis graminea ; Hesperis matronalis ; Heuchera sanguinea ; Hypericum Kalmianum ; Hypericum moserianum ; Hypochœris radicata ; Inula glandulosa ;

* These two interesting plants were, like several more plants in this list, killed by the frost last winter.

Isopyrum thalictrioides; Jeffersonia diphylla; Lamium maculatum; Lathyrus grandiflorus; Lathyrus latifolius; Liatris callilepis; Liatris cylindracea; Liatris pycnostachya; Liatris spicata; Linaria cymbalaria; Linaria Macedonica; Linum flavum; Linum monogynum; Lithospervnum prostratum; Lobelia cardinalis; Lobeliafulgens; Lobelia syphilitica; Lotus corniculatus; Lychnis diurna; Lysimachia clethoides; Lysimachia nummularia; Lysimachia nemorum; Lythrum salicifolium; Malva moschata; Melissa officinalis; Mentha pulegium; Mertensia virginica; Monarda didyma; Montbretia Potsii; Mysotis dissitiflora; Nasturtium palustre; Œnothera fruiticosa; Œnothera Youngii; Œnothera macrocarpa; Œnothera speciosa; Ononis arvensis; Origanum Canadense; Orobus lathroides; Pæonia lobata; Pæonia albiflora; Pæonia humilis; Pæonia officinalis; Pæonia peregrina; Pæonia tenuifolia; Pæonia Corallina; Papaver pilosum; Penstemnon glaber; Pedicularis sylvatica; Pityrospermum acerinum; Phlox amæna; Phlox canadensis; Phlox Nelsoni; Phlox procumbens; Phlox setacea; Phygelius capensis; Phyteuma comosum: Plumbago Larpentæ; Podophyllum peltatum; Polemonium hurnile; Polemonium himalaicum; Polemonium reptans; Polemonium Richardsonii; Potentilla formosa; Primula capitata; Primula cashmeriana; Primula courtusoides; Primula denticulata; Primula Japonica; Primula viscosa; Ramondia pyrenaica; Ranunculus acris; Ranuncunlus amplexicaulis; Ranunculus arvensis; Ranunculus bullatus; Ranunculus parnassifolius; Ranunculus Thora; Rheum palmatum; Rudbeckia maxima; Rudbeckia Newnanni; Santolina incana; Saponaria Calabrica; Saxifraga hosti; Saxifraga hypnoides; Saxifraga pectinata; Saxifraga cordifolia; Saxifraga crassifolia; Saxifraga orbicularis; Saxifraga Straycheyi; Scabiosa caucasica; Scabiosa graminifolia; Scrophularia nodosa; Scrophularia scordonia; Sedum acre; Sedum kamtschaticum; Sedum spectabile; Sedum Telephium; Sempervivum Tectorum; Senecio Doronicum; Senecio Jacobea; Senecia pulcher; Sildacea candida; Silene alpestris; Silene pendula; Sisyrinchum grandiflorum; Soldanella minima; Soldanella montana; Solidago virgaurea; Spigelia marilandica; Spirea aruncus; Spirea palmata; Spirea fillipendula flpl; Stachys lanata Stachys Betonica; Statice Gmelini; Statice latifolia; Statice bellidifolia; Tanacetum vulgare; Teucrium scordonia; Thalictrum minus; Thymus citriodorus aureus; Torilis nodosa; Trollius asiaticus; Trollius europeus; Trollius Lodgianus; Thermopsis fabacea; Valeriana dioica; Veratium Album; Veratrum nigrum; Veronica longifolia subscssilis; Veronica amæna; Vinca minor; Xerophyllum asphodeloides.

Report on the Society's Work as a Corresponding Society of the British Association for the Advancement of Science.

By EDWIN SEWARD, R.C.A., Delegate.

AT the Annual Meetings of the British Association for the Advancement of Science, there are very few of the papers and addresses, and discussions therefrom arising, which do not cover some portion of that wide field of work which the corresponding Societies of the Association can find to do. Any such work may well be a contribution of value to the general progress of scientific investigation. It is one of the privileges of the Cardiff Naturalists' Society to be—as a local organisation—one of the British Associations' Corresponding Societies, and to join year by year in that general programme of detail work which the British Association is by such agencies able to promote.

A list of these subjects would take a long time to read, and I will therefore content myself by naming those with which this Society or its committee have been concerned,—though but very slightly in some cases. In all of these, however, it is to be remembered that members of the society can at all times find an opportunity for making a start with any of those subjects which may be attractive to them, and a few words or a line to Mr. F. T. Howard who has kindly acted as honorary secretary to these sections of work—Research Committees as we have styled them—will certainly elicit good guidance for following them up.

The Delegates' Conferences were held in that beautiful building the Examination Schools, in High Street, Oxford, and they were well

attended on each occasion. The following are some of the matters referred to :—

Photography for Geology.—One or two were sent from Chepstow. The Bath Society's representative stated that amateur photographers, as well as professionals, look too much for pictures, and thus neglect the geological features. The photographs will be filed in the Jermyn Street Museum, and will be offered for sale upon a publisher being found.

Earth Tremors.—Mr. Horace Darwin exhibited and explained the construction and use of a new bifilar pendulum for noting and recording movements of the earth's crust, which pendulum would be undisturbed by surface shakings like those caused by passing vehicles. At Birmingham Mr. Davison had detected pulsations which were found to be produced by earthquakes then taking place in Greece, and in one of the deep coal mines of the Newcastle district pulsations which had been noted were found to indicate two separate actions,—one the settlement of the ground owing to the gradual removal of coal, the other, the beating of waves on the distant coast. In connection with experiments in coal mines it was suggested to me as the delegate from South Wales, that a pendulum might be placed in a deep mine in South Wales, and I promised to bring the subject before the Society. I have done this but it is not an easy question to deal with, for the cost of apparatus alone would be nearly £70.

Erratic Boulders.—There were few reports this year on the distribution of erratics. It happens, however, that several years before the British Association made this one of its subjects, valuable work was done in this Society by Mr. Edgeworth David, and also by Mr. John Storrie. These I gather from Mr. Howard, will be forwarded as contributions from this Society to the Association for the coming year. In this section I may remind members that good work iscontinually open ; work which would give a pleasing and useful zest to many a country ramble in the south eastern part of Glamorganshire and the valleys to the north of it.

Teaching of Science in Elementary Schools.—This subject is only touched here because of the excellent matter it might afford for treatment by at least one of our members, who has a wide experience of elementary education and of scientific subjects applicable to it.

Zoology, Botany, and Geology of the Irish Sea.—This again merely suggests what a useful field for investigation is to be found in our own Sea,—the Bristol Channel, respecting which members of this Society have done a good deal already, and may perhaps be prepared to systematise it so as to allow of reporting to the British Association.

Ethnographical Survey.—Our district is quite a borderland of races, and without great effort could be shown to have much special interest.

Report on Local Museums.—The chief feature of the Conference of Delegates from corresponding societies was an interesting discussion on museums opened by a paper from Mr. Cuthbert Peek, who is well

known as the owner of a most interesting private museum at Rousdon, on the South Devon Coast. He dealt in a very thorough manner with the following points :—

1. Methods of registration and cataloguing.
2. The protection of specimens from injury and dust.
3. The circulation of specimens, and type collections for educational purposes.
4. Central referees for nomenclature and classification.
5. The most satisfactory method of making museums attractive.
6. Museum lectures and demonstrations.
7. The relations between museums and County Councils.

Each of these heads led to interesting and useful discussions by the delegates. Those touched on by your delegate as also representing the Cardiff Museum were Nos. 5 and 6,—*The most satisfactory methods of making Museums attractive ; and Museum Lectures and Demonstrations.* In reference to the latter I spoke of some intention to institute in the Cardiff Museum short descriptions, more or less elementary in their scope, of the objects of Natural History, Archœology, and Art.

The chief point arising thereon was a suggestion from Mr. Peek that such short lectures should be given only on some previously understood occasion : that the audience should be limited to about 12 in number, and that the curator or lecturer should be provided with a light movable stand so as to enable him to command his audience and the specimens.

Under this heading a resolution was moved by Sir Douglas Galton, that local Natural History Societies and others in charge of museums use their influence to obtain support from County Councils and educational authorities, in promoting lectures and demonstrations in museums. It is interesting to find within the past week or two, that in the new Education Code, the attendance of children under recognised conditions at public museums and art galleries, will be counted as hours spent for purely educational purposes. In such directions it is easy to see that the old musty and dusty uncared for museum as it has existed in some local centres, is to become only a recollection of the past, and there is thus an even more useful future than ever for such institutions being developed on lines of true usefulness and attractiveness.

Prehistoric and Ancient Remains of Glamorganshire.—The report on this subject allowed of reference being made to the latest progress in one or two local matters thus :—"The Cardiff Naturalists Society have already carried out useful archæological work within the county. Of the inspections, reports, and sketches, &c., which have been made one may be specially mentioned, viz., a paper by Mr. T. H. Thomas on the ancient inscribed crosses of Glamorganshire, beautifully illustrated by photographs, and published in the Society's transactions for 1893. Through the museum committee of the Cardiff County Council casts in plaster of two of the most remarkable of these crosses

have been secured. These casts have lately been placed in the Cardiff Museum as a nucleus of a typical collection of casts of the ancient inscribed stones and crosses of Glamorganshire. In addition, the whole of the known inscribed crosses, with two or three exceptions, have been photographed by Mr. T. Mansel Franklen, the clerk of the peace for Glamorganshire, and these are available for purposes of study in the reference room of the Cardiff Central Free Library. During June and July, 1894, examination of certain mounds on the Ely Racecourse, near Cardiff, was made by the Cardiff Naturalists' Society. These mounds were first discovered by Mr. John Storrie, one of its members. They proved to be the remains of a considerable Roman villa, and fragments of hypocaust pipes, of Samian ware, and light grey prehistoric pottery, together with black pottery and Roman coins, have been found. The work of excavation is being continued from a fund raised by the Naturalists' Society, which it is hoped will be increased by subscriptions from the public."

The Circulation of Underground Waters.—The most comprehensive help in this section was that rendered by the Cardiff Naturalists' Society. Its reports and tables of sections disclosed in various parts of our district, and records of borings down to a depth of 336 feet, cover no less than seven pages of the annual volume of the Association.

Mr. Howard will, I understand, be able to submit a supplemental report next year.

In addition to the above, papers were contributed to the Association by Cardiff members as follows :—

Principal Jones.—Special Reports on value of Ohm.

J. W. Thomas.—On Chemistry of Coal Formation.

J. B. Haycraft.—On Rôle of Sex in Evolution, and on two Physiological Subjects, viz.,—on Striped Muscle ; on Development of Kidney.

Rev. Hartwell Jones.—Relations between Body and Mind as expressed in early Customs, Languages, and Myths.

It thus appears that whilst there is necessarily plenty of work remaining for the scientifically disposed, and which (if fulfiling conditions of ordinary usefulness) will be welcomed by the British Association,—Cardiff has not held during the past year or two a merely perfunctory place on the list of the societies which are in official correspondence with the British Association.

Archæological Section.

DURING 1894 proposals, which had for a few years been put forward by members of the Society, took effect in the formation of a section for following up the archæological work of the district, which had been found to be continually brought into touch with the work of the Cardiff Naturalists' Society. Mr. Edwin Seward, president of the Society in 1894, was asked to take the matter in hand as Honorary Secretary, and a committee was formed in April, 1894, from which a communication was sent to all members of the Society.

The response allowed for a beginning being made with about 50 members, the following gentlemen forming the committee :—

President: The Rev. Canon Thompson, D.D.

Vice-President: Mr. Wm. Riley.

Hon. Sec. and Hon. Treasurer: Mr. Edwin Seward.

Mr. J. S. Corbett. Mr. C. B. Fowler. Mr. T. H. Thomas.
Mr. John Ward. Dr. C. T. Vachell.

Visit to Llancaiach Fawr and Gelligaer.—The first visit was made on July 27th to Llancaiach, where an interesting old family mansion, now used as a farm house was inspected. Some oak wainscoat in some of the rooms, cast-iron fire-backs of late Jacobean character, and well preserved oak furniture of a little later date were examined and discussed, together with the general arrangements of the old house, which has a fine "pleasaunce," ornamented with fur trees, on the north side, and a front garden, surrounded by stone seating places, backed by walling.

Mr. J. S. Corbett gave a historical description of the house, which had until recently been in the possession of the Prichard family, but is now owned by Mrs. Mackintosh.

The members then walked to Gelligaer, being received by the Rev. T. Jones, the rector, who pointed out the outlines of the large

Roman camp of Gelligaer, showing also some fragments of Roman pottery, which he kindly stated he would send—through the President of the Section—to the Cardiff Museum.

The Church of Gelligaer was then inspected, the members examining with interest the tuncated form of the tower and its flat-shaped gargoyles ; a pair of stocks retained in the belfry, and a large baptistry close to the south entrance, inside the Church, of comparatively recent construction.

The walk was continued to Maesycwmmer and Hengoed, from which Cardiff was reached at 8 p.m.

The formal opening meeting of the Section is held over until the spring of 1895, when the President promises an address, whilst a programme of visits during the ensuing summer season has been formulated by the committee.

CARDIFF NATURALISTS' SOCIETY.

Ely Excavations.

Statement of Receipts and Expenditure.

1894.	£	s.	d.
To Cash to Mr. J. Storrie for superintendance of work —June 2nd to Aug. 31st	45	15	8
,, Cash to Messrs. J. Williams & Sons for Tools, etc.	2	19	10
,, Cash for Hurdles	5	8	0
,, Cost of Hut	6	5	0
,, Cash to Mr. W. Emerson for Wages of Labourers	22	13	3
,, Cash to Mr. W. Emerson for Compensation for Disturbance of Land	7	0	0
,, Cash to Mr. J. Strachan for filling in Excavations	5	5	0
,, Cash to Messrs. Duncan & Sons for Printing ...	3	7	5
,, Sundries	1	0	6
,, Balance	4	9	1
	£104	3	9

1894.	£	s.	d.
By Grant from Society	25	0	0
,, Subscriptions from Members and others (as per list published in Transactions)	70	14	0
,, Amount of Takings for Admision to Excavations...	1	4	9
,, Cash of Mr. W. Emerson for Hurdles	2	0	0
,, Cash of Mr. J. Strachan for Hut and Tools ...	3	4	0
,, Abatement in Mr. J. Strachan's a/c for filling in ...	2	1	0
	£104	3	9

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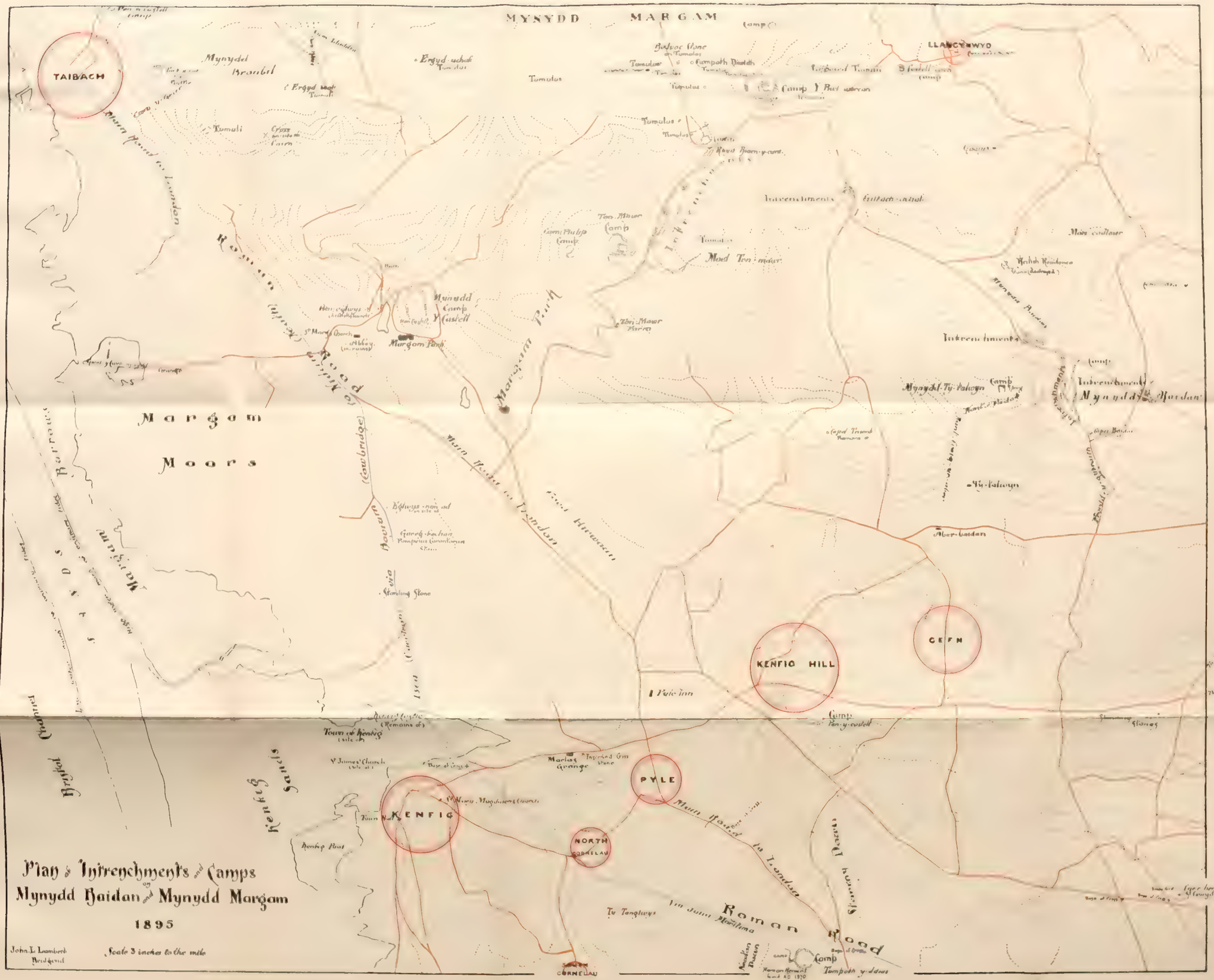
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TAIBACH
LLANGEWYD
Mynydd Bramble
Tumulus
Camp
Roman Road to Loventium
Roman Road (Cowbridge)
Margam Park
Margam Moors
Margam Abbey
Mynydd Margam Camp
Mynydd-Ty-Palwyn Camp
Mynydd Margam
Mynydd-Ty-Palwyn
Aber-Lavan
Roman Road to Penydarren
Roman Road to Loventium
Roman Road
Inclosures
Standing Stone
Town of Kenfig
KENFIG HILL
CEFN
PYLE
KENFIG
NORTH CORNELAU
CORNELAU
Pyle Inn
Camp Pen-y-castell
Marlas Grange
Kenfig Burrows
Kenfig Sands
Bristol Channel
Roman Road
Camp Tempath yr Ddau
Plan of Intrenchments and Camps on Mynydd Baidan and Mynydd Margam
1895
John L. Lambert Bridgend
Scale 3 inches to the mile

CARDIFF
NATURALISTS' SOCIETY.

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St. Mary's Church, Coity.—1896.

Intrenchments and Camps on Mynydd Baidan and Mynydd Margam.

By WILLIAM RILEY

(Field Walk of the Archæological Section from Bridgend to Margam).

THE first Field Walk of this section of the parent Society was for the purpose of investigating some of the objects of archæological interest in which the neighbourhood of Bridgend abounds, and which, to the reflective mind, afford such infinite scope for study and research into the history of the primitive inhabitants of the country of whom no written records exists, and also into the life and customs of early historic and mediæval times.

The morning was bright with the glinting radiance of the rising mid-summer sun, when a large party of members of the section assembled in Cardiff's commercially busy and progressive town, and were in a few fleeting moments in the midst of the secluded village of Coity, amid the footprints of the early races of invaders who conquered, and so firmly held for long generations, the fruitful land of Glamorgan's Vale. It was fitting that, with hearts of peaceful veneration, we should first visit the ancient church which appears in view, nestling in quiet security under the grim ruins of the adjacent Norman castle. We enter the churchyard, and in the vicinity of the porch stands, in the full vigour of mature life, a yew tree of large size and great antiquity, its main trunk being 14 feet in circumference, with enormous limbs spreading horizontally some 35 feet, and covering a diameter of 52 feet, its close branches, covered with dark green linear leaves, and clustered with curious blossoms. This takes us back to the time when

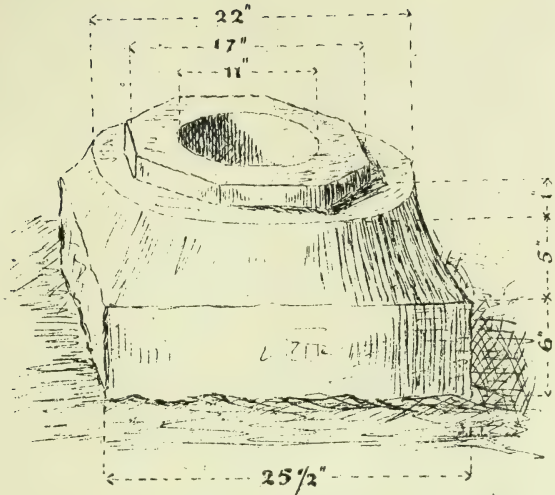
pious hands on the Palm Sundays of past centuries used the foliage of this tree as palm branches, and reverently laid them in front of the high altar, and carried them in procession, thus symbolizing the victory over the prince of death. Under its soothing shade, in the quiet solemnity of its surroundings, the wearied have ofttimes found a haven of rest for meditation and prayer through many by-gone ages.

Under the west wall rests the square stone base of the ancient cross, with a circular mortice 11 inches in diameter for the shaft—an unusual form as the socket is generally square. These old churchyard crosses belonged to the old church life, and formed one of its holy features—a symbol of Christian faith of great significance. And in these fast closing days of the nineteenth century, it is hopeful to find an earnest feeling surging through the hearts of the great Cymric people for the restoration and preservation of these relics of their pious ancestors.

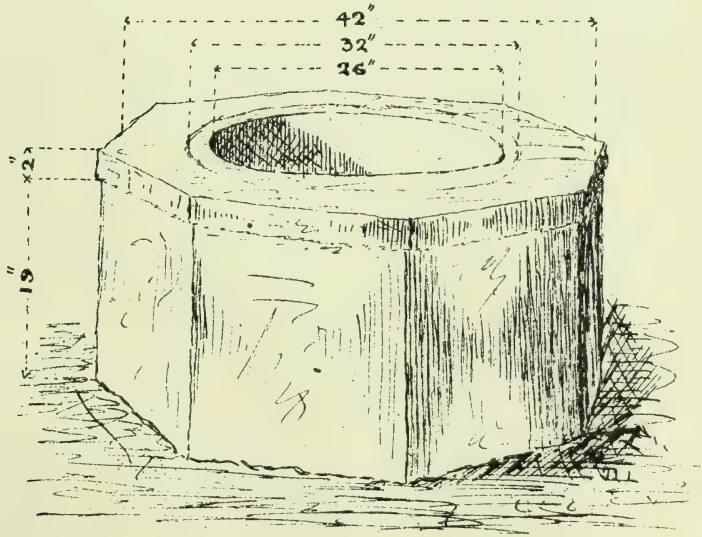
Near the cross base is the font, probably dating co-eval with the church. There it lies,—octagonal in shape, roughly hewn from a block of hard sandstone, with a circular cup sufficiently large to allow of the total immersion of an infant. Fonts of this shape, with circular basins of lead, probably date from the eleventh century. They became common in the thirteenth, but in the fifteenth the cup itself also assumed the octagonal form.

Up to the restoration of the sacred edifice (some thirty years since) this font was used for the purposes of baptism, but is now replaced by a modern decorated one of Bath stone, out of keeping with the ancient church. Is it too late to plead for the replacement in its original position of that receptacle for consecrated water, hallowed by the memories of long generations of mankind,—where they and their children were brought to receive the sacrament of baptism, and thus make their first entry into a Christian Church, and into civil life by the bestowal of a name.

We enter the church (which is dedicated to St. Mary) by the south porch. On the right-hand side is seen the niche in which stood the stoup or vessel which contained the holy water which the worshippers in pre-Reformation times made use of on entering and leaving the church. There is also another hollow for like purpose on the right side of the western entrance. The nave is proportionately very large, with a grand closely-ribbed roof of the oak used in its original construction, and it has, apparently, successfully withstood the ravages of time. The central tower rises abruptly on its four stone arches with a stone-groined roof, from under which the bells are rung, and to the north and south are the transept chapels, each containing a trefoiled piscina for the water used in the ablutions of mass. In the chancel are a raised altar and fine piscina and sedilia (two in number). In the key-stone of the chancel arch, facing east directly on the altar, is a curious little effigy worked in the stone itself—the half figure of a man—bare-headed, and in armour of chain-mail. In the chancel floor, incised in stone, is a record of the revolutionary times of the middle of the seventeenth century.



Base of Cross . Corby



Font Corby Church

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APTH VPON THE IMMATVRE AND VNTIMELY DEATH OF
GAMAGE OF BRIDGEND MERCER THE 7TH BEGOTTEN SONNE
GAMAGE OF COYCHVRCH GENT WHO BY THE VOILENCE OF
MEN DEPARTED OVT OF THIS LIFE THE 22TH OF FFEBRVARIE
YEERE OF OVR LORD GOD 1650 AND OF HIS AGE 36

EN RELIGION NOW ADAYES PRETEND
THEIR DEEDES WE SEE WHAT THEY INTEND
VEIL DEATH DOETH MANIFEST THE SAME
EIR CONFVSION AND THEIR VTTER SHAME
THAT NONE WERE GVILTIE OF THAT ART
MAKES THE TONGVE REPVGNANT TO THE HEART

HEERE LYETH THE BODY OF IANE
THE WIFE OF THE SAID EDW
ARD GAMAGE WHO AFTER WA
RD WAS MARRIED VNTO WALTER
MORGAN GENT DECEASED THE
25TH DAY OF MAY 1660

ANOTHER

LE THAT IS BVILT WITH STONES AND LIME
OT WITH STAND BVT FOR A CERTAINE TIME
VSE OF CLAY WITH EASE IS BATTERD DOWNE
THINE IS BATTERD TO THY GREAT RENOWNE

And in an adjacent wall another Gamage bears testimony in stone of the kindly favours received from the hands of a rector of this church.

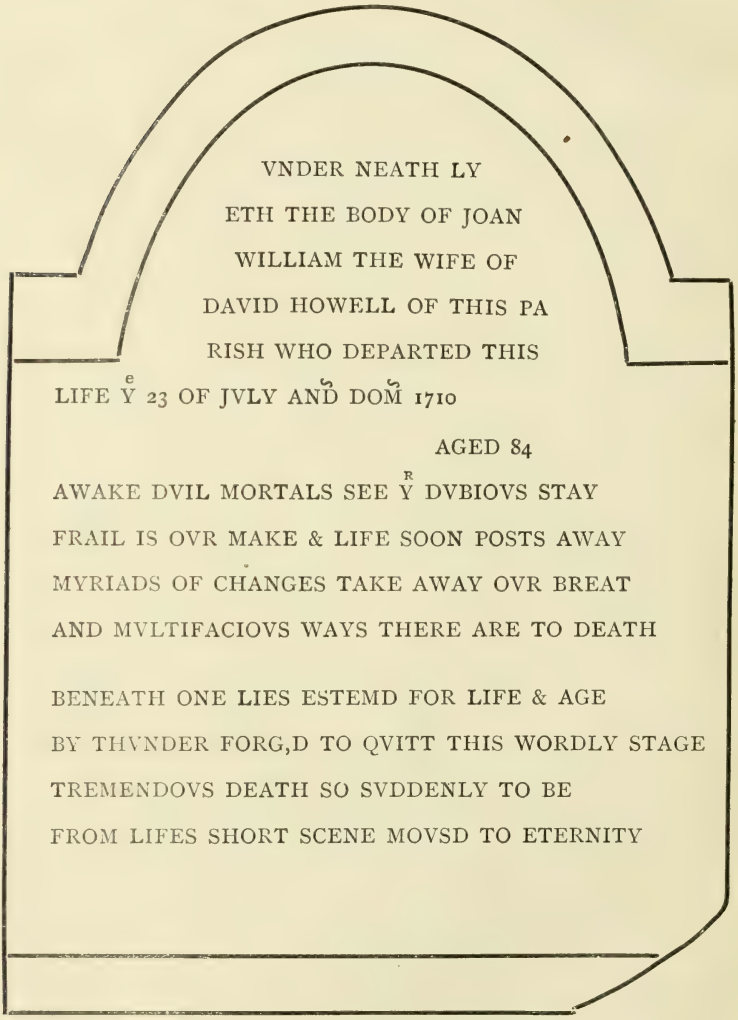
READER OBSERVE, THIS IS THE END O ALL
FEW ARE OVR DAYS, AND THEN OVR FVNERALL
WILL HIDE OVR HEADS IN EARTH, WHERE FORE= PREPARE
AND MAKE THY PEACE WITH GOD THEN CAST OF FEARE
CLOASE THOV WITH CHRIST THY SAVIOUR THAT THIS DEATH
MAY NOT DISTROY THEE, THOVHIT TAKS THY BREATH
LEAVE OF THY CASEINGE, MOVNT THY THOUGHT= ON HIGH
AND WHILST THOU ART YET LIVING, LEARN TO DIE

THIS MONVMENT WAS ERRETED, BY EDMVND=
GAMAGE OF NEWCASTELL, ESQVIER, TO THE
MEMORY OF THIS HONORED PARSON, IN ACKNOW
LEDGEMENT OF THE MANY VAVRS, HERECEIVED
FROM HIM.

LET HIM REST IN PEACE

Coity remained for seven descents in the hands of the Gamage family, during the fifteenth and sixteenth centuries. The mother of Lord Howard of Effingham, Lord High Admiral of England, was a Gamage of Coity.

Another memorial stone is here, and of quaint interest.


VNDER NEATH LY
ETH THE BODY OF JOAN
WILLIAM THE WIFE OF
DAVID HOWELL OF THIS PA
RISH WHO DEPARTED THIS
LIFE Ye 23 OF JVLY AND DOM 1710
AGED 84
AWAKE DVIL MORTALS SEE Yr DVBIOVS STAY
FRAIL IS OVR MAKE & LIFE SOON POSTS AWAY
MYRIADS OF CHANGES TAKE AWAY OVR BREAT
AND MVLTIFACIOVS WAYS THERE ARE TO DEATH
BENEATH ONE LIES ESTEMD FOR LIFE & AGE
BY THVNDER FORG,D TO QVITT THIS WORDLY STAGE
TREMENDOVS DEATH SO SVDDENLY TO BE
FROM LIFES SHORT SCENE MOVSD TO ETERNITY

In the north transept lie recumbent two effigies of great historic value, in a position of considerable danger, lying as they do detached

Turberville Effigies at Coity Church.—1896

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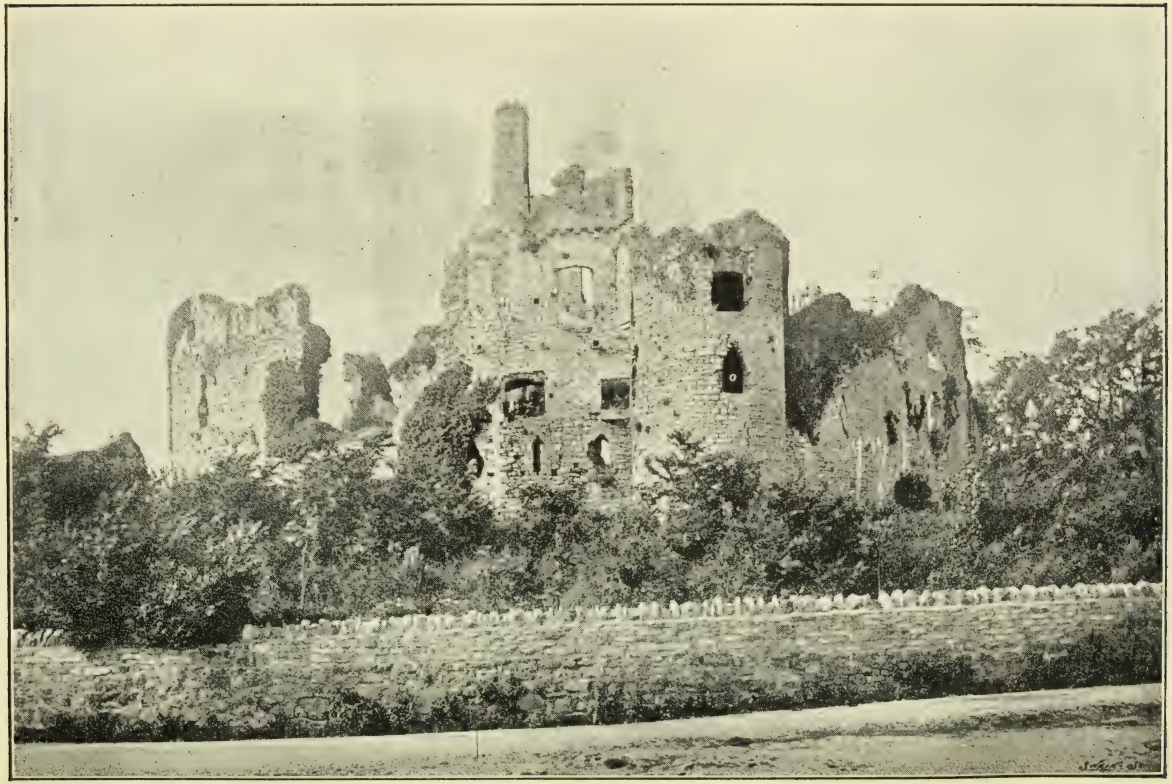

Coity Castle, Glamorganshire.—1896.

on the stone slabs used for seats; they should be preserved from destruction by being fixed in a niche in the northern wall. They represent the wife and child of an ancestor of an honoured family still living in the near vicinity, and are of earlier date than any other monument in the church.

One effigy is that of a female, with hands folded in prayer, with flowing robes, and feet resting on a circular piece, supported by a small animal eating an oak leaf. The inscription, in Lombardic capitals of the 13th century, reads :—

DE : PAVN : TURBVILE : GIT : ICI : DEV : DE : LALME : EI

The other effigy is that of a child, the inscription on which is destroyed, but there can be deciphered :—

PAVN : TURBERVLE

Mr. G. T. Clark, in the "Genealogies of Glamorgan," gives a Payn Turberville, who died about A.D. 1207. He married Sybilla, probably the daughter of Morgan ap Justyn, Lord of Glamorgan; but these two effigies, without doubt, commemorate the death of Wenllian, daughter of Sir R. Talbot, of Richards' Castle, by Sarah, daughter of William Beauchamp, Earl of Warwick, and widow and executrix of Sir Payn de Turberville, who died about A.D. 1319, and their infant daughter.

We linger to gaze on the cold, lifeless images in stone, and feel impressed with a sense of sympathetic pity for that Norman mother and her child. But even after the lapse of six long centuries of time, there stands in our presence a link of continuity between the living and the dead in the humble caretaker of the church—Martha Stradling. She is the sole supporter of an afflicted brother, deprived of sight whilst earning his livelihood as a collier, the lineal descendants of the great Sir Edward Stradling, of St. Donat's (Knight of the Sepulchre), who married a close relative of this lady. Such is the irony of fate!

The curious carved oak chest was examined. The communion plate is dated A.D. 1633. The register dating from A.D. 1720. The tower is embattled in half military style.

We leave this bulwark of Christianity—this church which has lived, and is living still in the hearts of the Welsh people, for the ruined castle of a lordly knight, who came and conquered. Proud of his great possessions and of his lineage, he erected this, his Norman keep, on the earthworks of a British chieftain.

Sir Payn de Turberville, by right of conquest, gained the Manor, and built the Castle of Coity probably soon after A.D. 1091; but Mr. Clark, in his "Mediæval Military Architecture," writes that a descendant, Sir Gilbert Turberville, who was in possession A.D. 1207, may well have been the real constructor. It was evidently a place of great importance

and vast strength, with a rectangular keep, inner ward, and round flanking tower, the whole surrounded by a moat of great width and depth. The outer ward is a later addition to the original circular inner ward enclosure. The interior is in a ruinous state, a complete shell of its former massive grandeur; but still, here and there, fragments of worked stone are visible, some pertaining to the Tudor period, with Tudor rose chiselled ornate on the key stones at the point of intersection of the ribs of the groined vaulting. The gallant Turbervilles and their retainers, both horse and foot, did sturdy service for their country and their king in foreign lands, and held their stronghold, this well-nigh impregnable castle, securely against the resentful attacks of the despoiled natives until late in the 14th century, when it came by marriage into the hands of the Gamage family. Sir William was besieged by Owen Glyndwr, the last native who assumed the title of Prince of Wales, and who, to regain the freedom of his country, A.D. 1400, ravaged the districts where Norman castles overawed his countrymen. This devoted patriot never submitted, but died, it is supposed, in Monmouthshire, after A.D. 1416. The Gamages continued in possession of this manor and castle until A.D. 1584, when it went by the marriage of Barbara to Sir Robert Sidney, Earl of Leicester, and remained with his descendants until A.D. 1742.

The earthworks to the north of the castle were visited—the shelter trenches of an attacking force. The cottages, quaint and homely, with stone unmoulded mullions and pointed arch and their picturesque thatched roofs, sent to us flashing thoughts as to the social condition of their occupants in the feudal times, when, under Norman despotism, all freedom seemed to slumber, but yet never died, for here the proud home of the lordly knight is a chaotic mass, whilst the humble cottage of his vassal still prospereth, and he lives contented and in happiness and doeth neither homage nor "castle guard."

We speed over the weird common of Cefn Hirgoed to the elevated plateau near Pen-yr-Allt, and on the slope of a verdant field overlooking the River Ogmore stands erect a sculptured stone, evidently of the late Celtic period. It is a block of hard blue sandstone four feet in height above the soil, and of the width of two feet by eighteen inches in thickness, with a morticed hollow at the top, the former receptacle of a cross. The stone is beautifully incised with knotty and intricate tracing on its west, north and south sides, whilst the eastern side is a plain panel, and bears no trace of incision or chisel work. To the north, and closely adjacent, is a spring of gurgling, silvery water, bubbling into a well, protected by masonry of ancient date. This stone, this precious relic of past ages, stands in an exposed position in extreme danger of destruction by the thoughtless hands of man and of grievous damage by cattle. Ere it is too late, may an earnest wish be expressed, that this memorial of the Celtic people of Britain be preserved for all future time by the prompt, united action of those who stand forth in our county as lovers of archæology.

Careg-Fedyddiol, on Penyrallt Farm, near Cefn Hirgoed.—1896.

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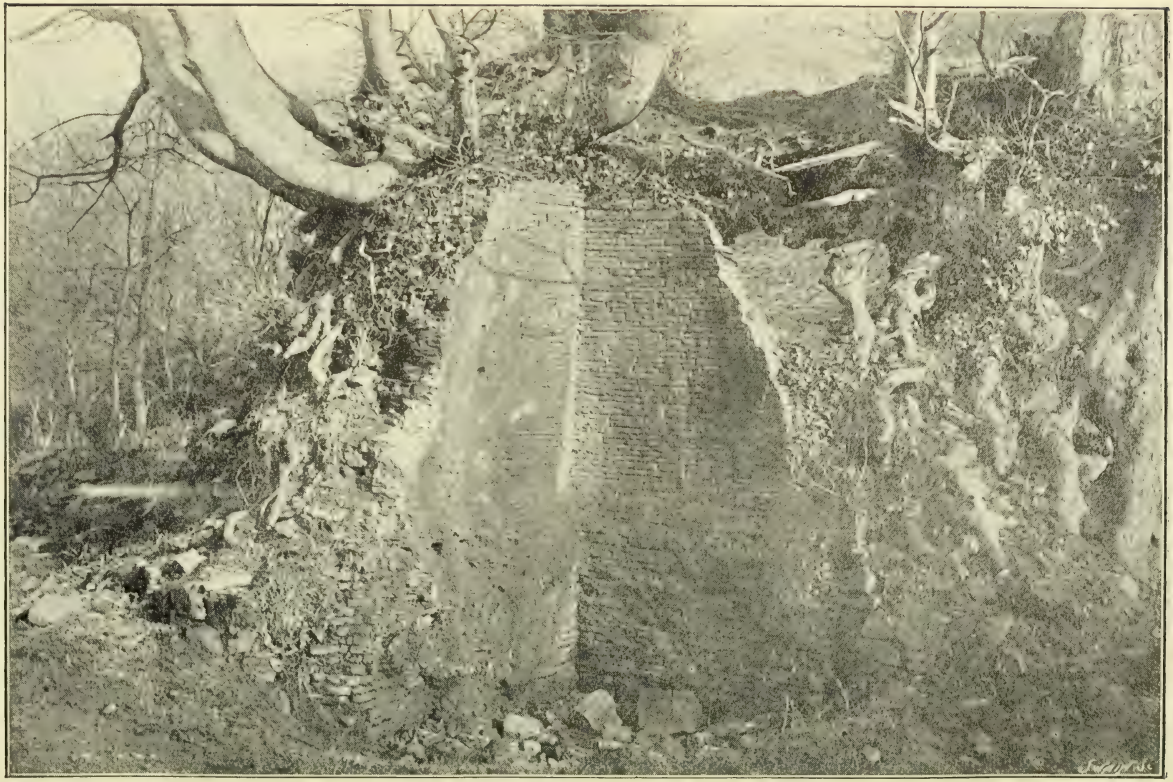


Y Gwaith Haiarn (The Iron Works).—1896.

Whom does this stone commemorate—this ancient monument wrought by tools in living hands, this link between historic and prehistoric man?—No inscriptions tell the tale; but here it stands in situ, for it is improbable, owing to the nature of the surrounding land, it has ever been even moved. Local tradition speaks of it as the baptismal stone, owing perhaps to its morticed cup; but probably the reason for its erection can with some truth be attributed to the early fathers of our Christianity to mark from afar the site of the holy well.

Under trees of British oak the party walked down a steep gradient to Ogmore's flowing stream. Near the left bank, on the windward (westerly) side of the hill, denoting its early date, prior to utilisation of the artificial air blast, stand the serried ruins of a blast furnace. Entwined in the interstices of its sandstone blocks grow the fibrous roots of a sycamore tree, rearing its head skywards in all the beauty of its brilliant foliage, but year by year bringing, by disintegration of its masonry, destruction to this interesting memento of an ancient industry.

The height of the iron furnace is 12 feet with a square of 6½ feet by 6½ feet, tapering at the top to 3 feet by 3 feet; with a wall-thickness near its foundation of 3 feet 9 inches. A section of about one-third alone remains; it is cased with old red sandstone, pure and free from marl, and the regularity of the courses of its 1¼″ blocks almost suggests a Roman origin, for iron was extracted from its ore in Britain at a very remote period, probably even earlier than the invasion of the Romans. In the near neighbourhood seams of clay-ironstone of the carboniferous strata crop out on the hill sides affording easy access to the mineral, whilst in the valley grew luxuriantly the hardwoods required for supplying the charcoal fuel. Pig iron was produced in this primitive smelting furnace probably for use at a forge on the river bank near by, but the doings of these old iron workers are veiled in obscurity.

Coal was not used for smelting purposes prior to A.D. 1611, and no coke or cinder has been here found. From the name of an adjacent village—Angeltown, formerly Anglish-town, the reputed dwelling-place of the early pioneers of the now vast iron industrial works of the valley,—it may be, with some safety, presumed that this ancient furnace originated with and was constructed by the enterprising and prosperous ironmasters of Sussex, who, in Tudor times, about A.D. 1509, established themselves in Glamorganshire. Mr. William Morgan, of Corbett-road, Cardiff, writes recently in the *Western Mail*, relative to this old blast furnace (y gwaith haiarn):—

"When here, many years ago, the hearth of the furnace was intact,—
"it was a square hearth,—not round, as they are now made,—and also
"part of the bosh. My object in visiting the place was to ascertain
"what kind of iron ore the old people used,—it was currently reported
"at that time that the Llantrisant hematite extended across the Llynvi
"Valley, and that the old people worked this hematite for their furnace.
"Failing to find iron, I turned my attention to the slag, or cinder heap,
"about 100 tons, which stands in front of the ancient furnace.

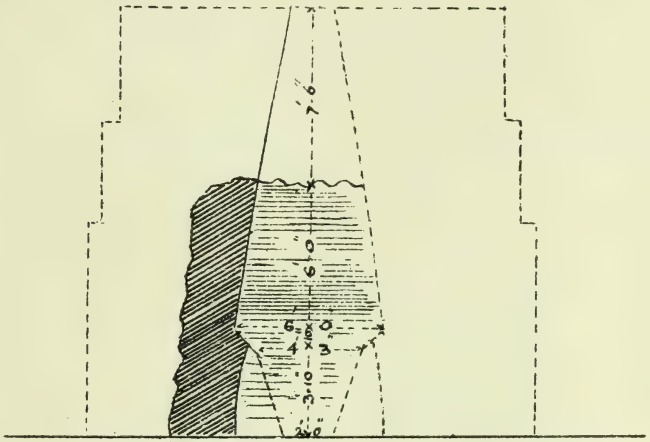
"In the slag heap I found pieces of charcoal, but no coke or coal, "from which fact I concluded they used as fuel charcoal only. I took "a fair sample of the slag and submitted it to analysis, which gave the "following results .—

"Silica	51.42	%	
"Alumina	18.85	,,	
"Lime	13.64	,,	
"Magnesia	1.66	,,	
"Protoxide of Iron	7.62	,,	= 5.93 Metallic Iron.
"Constituents not estimated ...	6.81	,,	
	"100.00		

"We thus find that alumina stands in proportion to the silica as one part "of alumina to 2.80 of silica, while the hematite ore of Llantrisant stands "as 1 of alumina to 47 of silica. Therefore, it was not hematite ore "they used. An average of thirteen samples of the Welsh clay bands "gave the proportion of alumina as 1 to 2.43 of silica, showing clearly "that it was the clay band ore from the coal measures that was used. "The next thing to be noticed in this analysis is the large quantity, "1.66 %, of magnesia, showing that it was not mountain limestone, as is "now used for a flux in smelting iron, but lias limestone, obtained from "Bridgend quarries. Again, the cinder was grey, such as we may expect "from the production of a No. 4 mottled iron, but the large quantity of "iron it contained, 5.93 %, showed that their process of smelting was very "imperfect and extravagant, such a cinder from a blast furnace of the "present day would not contain more than a half per cent. ($\frac{1}{2}$ %) of "iron."

Along Ogmore's Vale the cavalcade proceeded across the common of Penyfai, leaving on the left quaint cottages sheltering under rugged upturned strata of mountain limestone—a study for the artist—thence through Aberkenfig, and hard by the ironworks of Tondu, then westward, skirting the southern outcrop of the coal measures, and close under the ill-fated colliery of Park Slip, where a holocaust of destruction brought death to many noble workers, and bereavement into the cleanly whitewashed cottages which here and there dot the hilly ridge. With silenced and saddened feelings we leave this scene of sorrowful reminiscences and reach an ancient road, named in remote ages Ffordd-y-gyfraith (the road of the law.) Tradition speaks of mighty chieftains, who, when the lowlands were forest and morass, held courts in their mountain fastnesses in the near vicinity. We ascend and pass the site of Capel Baidan—(of which not a stone remains—it has disappeared—destroyed by ruthless hands)—and reach the eight hundred feet contour line above sea level, and then a panoramic view of great splendour surrounds us. Yonder, stretch far away, undulating hills and valleys, down even to the forest of masts which mark the locality of Cardiff Docks, whilst across the shining Severn the faint blue outlines of the hills of Devon and Somerset rise to sight, and looking northward, the grandeur of mountain peaks is revealed, and we realize we are approaching the summit of Mynydd Baidan—an historic name—for

Plan of Ancient Iron Furnace
near Angelton, Bridgend
Glamorganshire 1895



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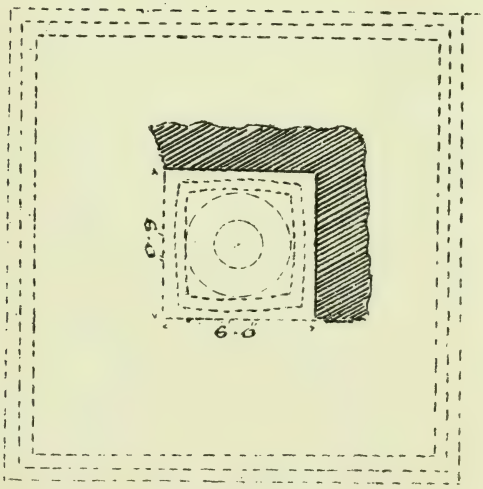

Plan

Scale 8 Ft. = 1 Inch

John. L. Lambert.
Bridgend

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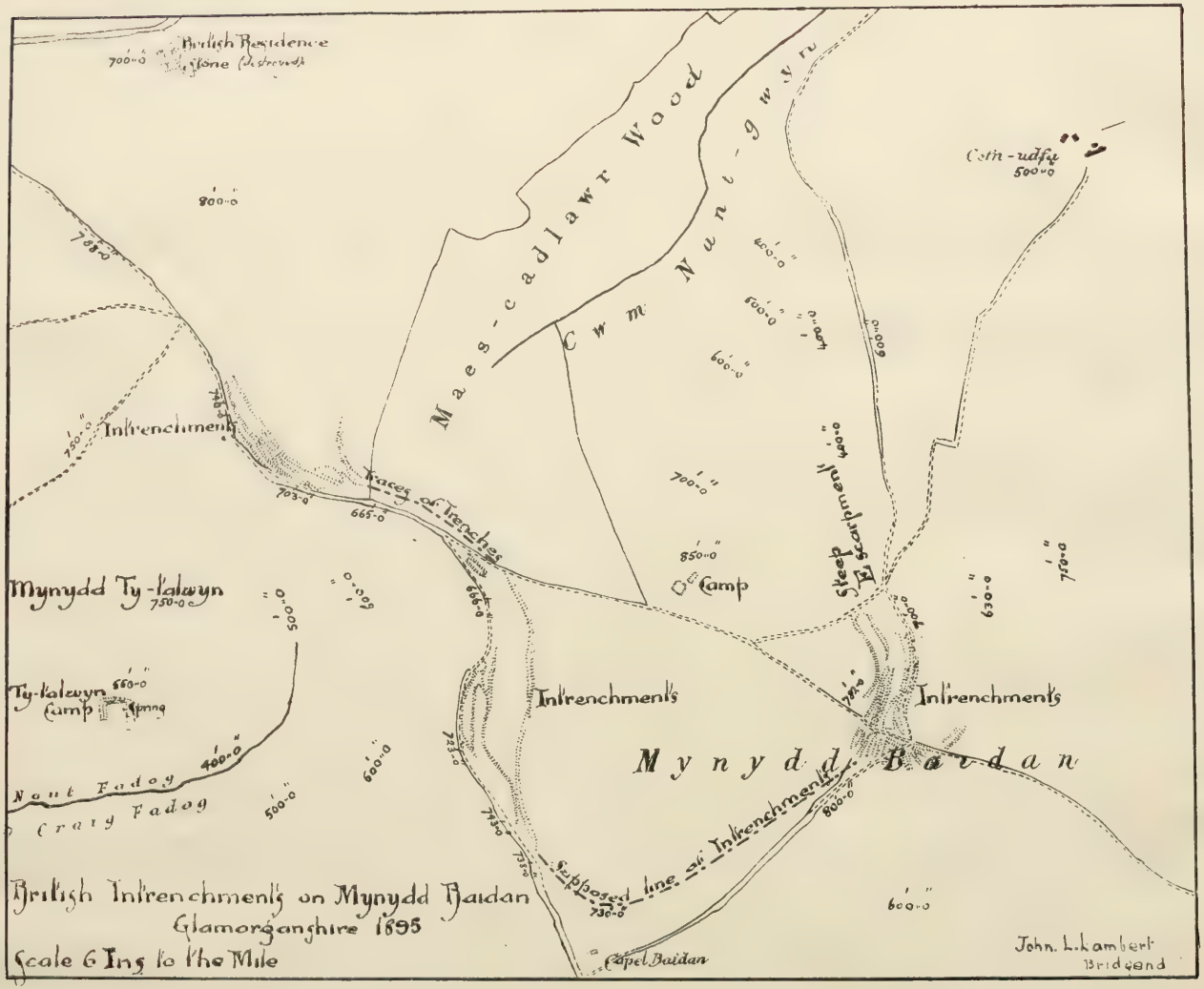
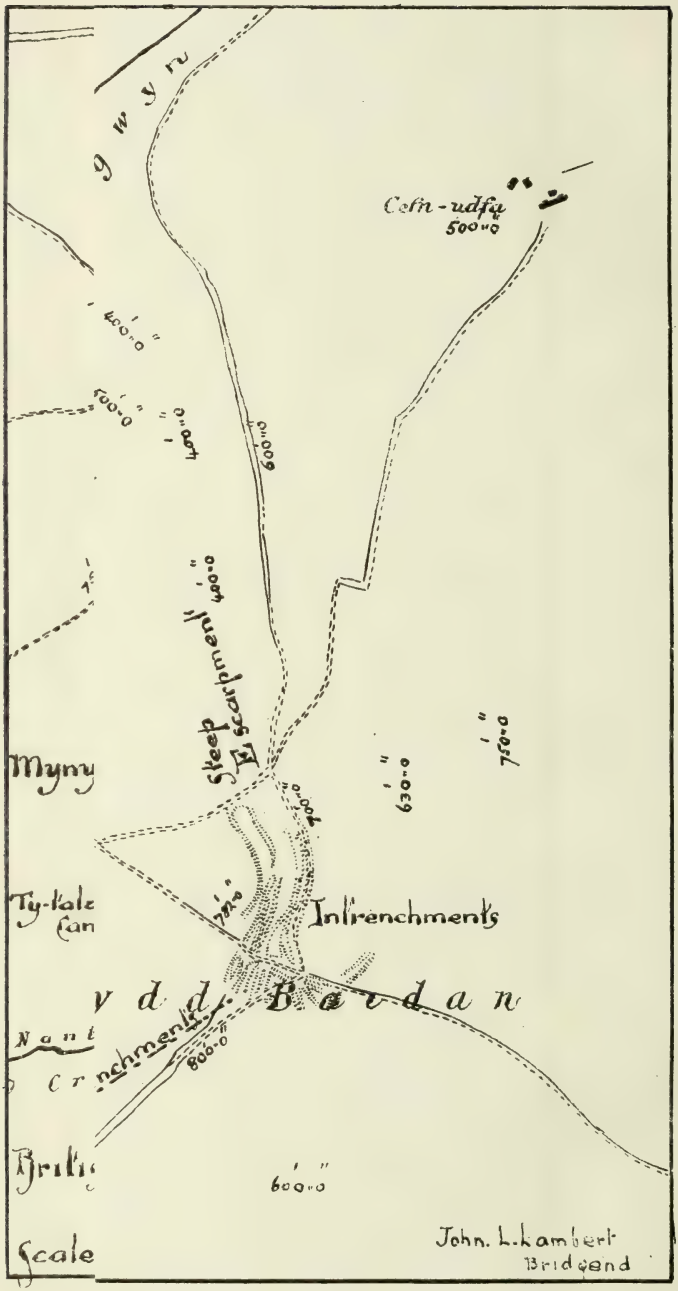

British Residence
Stone (destroyed)
Maes-cadlawr Wood
Cwm Nant-gwyr
Coth-cudfa
Intrenchments
Traces of Trenches
Mynydd Ty-Talwyn
Ty-Talwyn Camp
Camp
Steep Earthwork
Intrenchments
Intrenchments
Mynydd Baidan
Craig Fadog
Supposed line of Intrenchments
Capel Baidan
British Intrenchments on Mynydd Baidan
Glamorganshire 1895
Scale 6 Ins to the Mile
John. L. Lambert
Bridgend

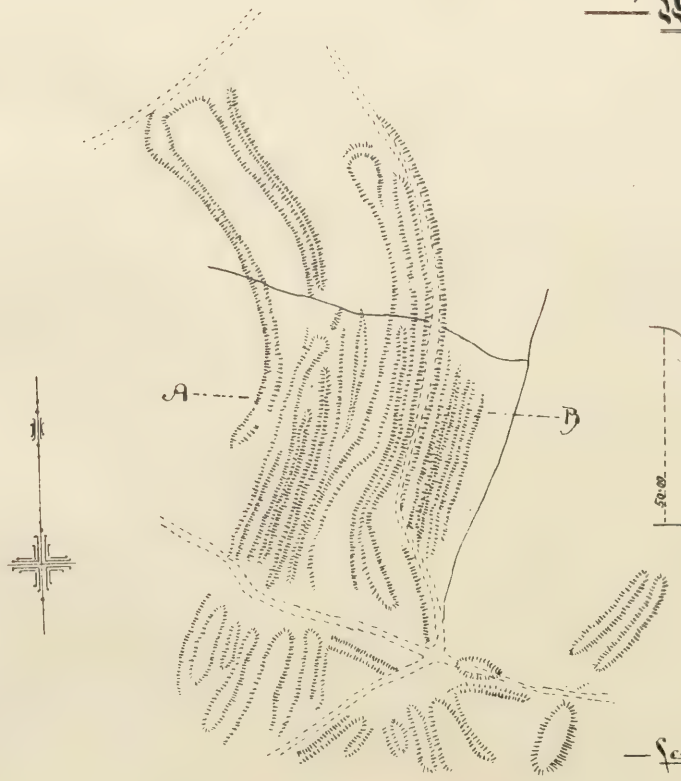

Gwyn
Cefn-uchaf
500-0
600-0
Steep Escarpment
400-0
Mynydd
630-0
750-0
Ty-Hale
Farm
Intrenchments
Vale of Bardan
Nant
Intrenchments
800-0
600-0
British
Scale
John. L. Lambert
Bridgend

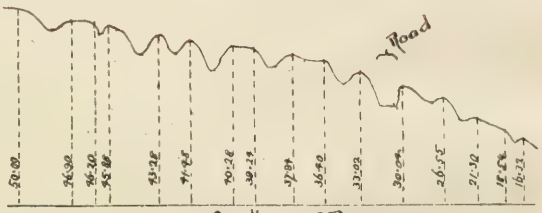
Section of Intrenchments

on East side of

Mynydd Baidan

1895 — Glamorganshire





Section AB

Scales of Section — { Horz 100 Feet = 1 Inch / Vert 40 Feet = 1 Inch }

Scale of Plan 208·33 Feet to the Inch

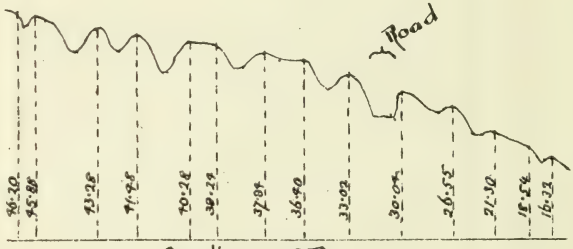
John. L. Lambert
Bridgend. Glam

# of Intrenchments

on East side of

Mynydd Baidan

1895 — Glamorganshire



Section AB

of Section — { Horz 100 Feet = 1 Inch / Vert 40 Feet = 1 Inch }

Sea

John. L. Lambert
Bridgend. Glam

Gildas writes that the Battle of Mount Badon was fought near Severn's Sea, A.D. 520. But as history speaks of this event with uncertainty and the death of that legendary personage, King Arthur, in this contest in dubious language, we ask ourselves : What can this mountain unfold or teach us of the history of the past?—for here, living hands in pre-historic time have scooped out vast series of ramparts, rising on the mountain slopes tier above tier, eleven deep. They skirted the steep slope of the hill, east, south, and west, and were originally some two thousand five hundred and sixty yards in extent, which means a continuity of fosse and vallum, from front to rear, of about twenty-eight thousand lineal yards. In parts, however, but faint traces exist where the soil has been for long ages under cultivation, but on the sterile land there is still bank over bank of earth of vast thickness, with ditches which, even after the climatic wear of twenty centuries or more of time, are five to seven feet in depth, and of a lineal measurement of nine thousand eight hundred yards of trenching. These intrenchments follow the sinuosities of the mountain, leaving the northern plain unprotected. To what race of mankind must we ascribe these immense and rudely-constructed earthen breast works? To what age do they belong? Evidently they were constructed for defensive purposes on a site judiciously chosen and by a people who had scant knowledge of strengthening defensive positions, for they are simply artificial lines of intrenchments, without any traverses inside guarding against flank attack. No relic has been found—nothing that has lived or been touched by the hands of man,—nothing but earthen mounds and trenches remain, and it requires a trained intelligence to piece together the puzzle of these gigantic works of a wild and barbarous people who possessed this land before Cæsar came.

But we cannot penetrate the remote past before the writings of Tacitus, the historian, and the advent into Siluria of the Romans, who under Ostorius Scapula, A.D. 51, fortified the line of the rivers Avon and Severn, and found the Celtic tribe of the hardy Silures contesting their onward march from the eastern to the western sea. The second Augustan legion crossed the estuary of the Severn. Those scarred veterans of Rome—imbued with an unquenchable military spirit—with all the prestige and lustre of victories—with superior arms and an iron discipline—were unconquerable. A great road was laid out, constructed as they advanced in an undeviating line from hill to hill, through swamp and forrest; from Venta Silurum (Caerwent), Isca (Caerleon), Bovium (Cowbridge) to Nidum (Neath), thence north to Brecon. Let us attempt to conjecture what the movements of the legion probably were. It halted on the boulder strewn plateau of Stormy down, near Pyle (before the era of the British camp at Penycastell on their right, or the circular Danish camp on the left of their road, via Julia Maritima). These invaders were confronted on their right flank by the heavily intrenched positions on Mynydd Baidan and Mynydd Margam, the protecting bulwarks of a royal clan of the Silurian people. This nation in arms, from their mountain fortresses, threatening both flank

and rear, were not to be despised. The legion, directed by a great strategist, changing front to the right, pushed up the valley of Ty-Talwyn, along the brook Nant Craig-yr-aber to Nant Fadog, but at the top of the ravine they were headed by strong earthworks on the height of the western side of Mynydd Baidan. A frontal attack being impossible, the advance was checked, and on the sloping side of Mynydd Ty-Talwyn a halting intrenched camp was constructed with single vallum and fosse. The Roman soldiery were confident in their prowess in arms to resist or repulse all efforts of their foe to dislodge them. That they did not hold their enemy too cheap is clear; for although the brook of Fadog flowed but a few short yards away, they took the precaution to enclose a spring within their lines. The camp was an exact square of two hundred feet each way; but cultivation has levelled the parapets of two of its faces, and partially destroyed its third side. Adjacent to it are circular hollows of doubtful origin, but pointing to the probability of being early British dwellings.

We ask ourselves what were the tactics of the commander of the legion. His experience would tell him after reconnaissance in force to attack the weaker flank of the position, and to concentrate his forces for this purpose. The left flank of the British intrenchments securely rested on the edge of a steep and unassailable ravine, whilst their right defences proved to be lines of open trenches. A section of the Roman forces showed themselves in front, whilst massed cohorts steal over Mynydd Ty-Talwyn and rush the intrenchments on this, the right and weaker flank, with columns of attack taking the works also in reverse. The bravery of the skin-clad woad-stained warriors of Britain proved of no avail against superior strategic science and tactical art. Over the intervening plain to Gilfach intrenchments the defeated army retired to make a futile stand—backward—still backward are they forced to earthworks lining Mynydd Margam, near by Rhyd Blaenycwm. These the Romans stormed and carried, and delved their camp on the site of the erstwhile British stronghold, thus affording a probability that these rude trenches were pre-Roman; for here we actually have a British trench cut through and surmounted by a Roman camp, constructed with the exactitude habitually observed by these people; the same in size and plan as their camp on Ty-Talwyn. Forced from their fortifications, the Silures manœuvred in the field, showing a determined front, armed with javelins, arrowpoints of metal and chipped flint, and clubs, to the onslaught of the Romans, who, clad in defensive armour, and using as weapons the short sword, a spear, and shield, advanced like a billowy swell in compact squares against the Celtic centre, which rested on the apex of a tumulus known as Ergyd Uchaf (highest blow). Down the declivity in their rear were these heroes driven; but fleet of foot, and with true British hearts, they made another gallant stand on the rising ground near the tumulus, still called Ergyd Isaf (the lower blow); but all in vain, for far, far down to the northward we read these words of terrible significance: "Cwm Lladdfa" (the valley of slaughter). May this victory have been tempered with mercy! Perhaps it was so, for a

Camp
on
Nynydd-Dy-Talwyn
Ynynydd Baidan

1895 *Glamorganshire*

Scale 208 33 Feet to the Inch

John. L. Lambert
Bridgend
Glam.

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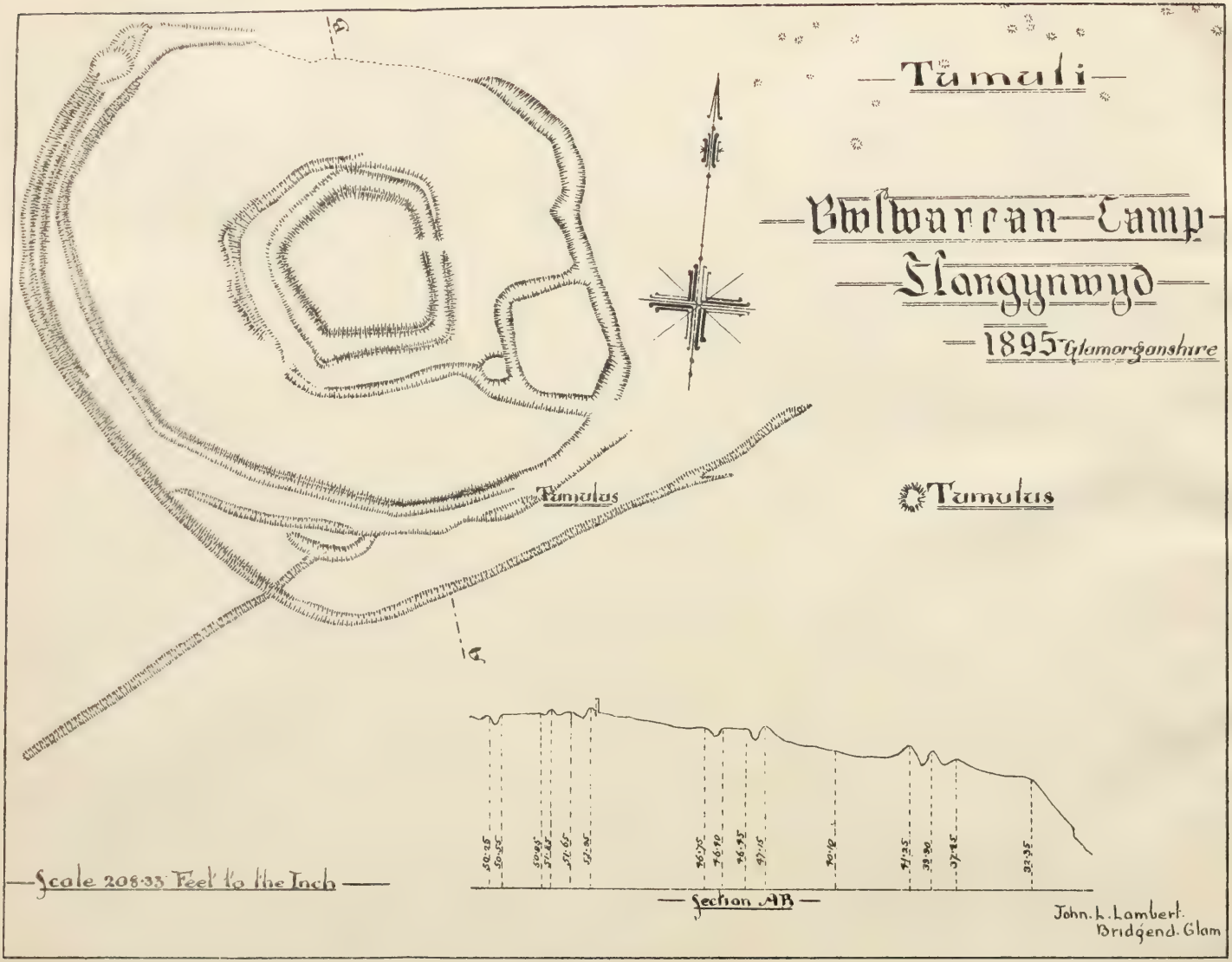
Tumuli
Bwlwarcan Camp
Llangynwyd
1895 Glamorganshire
Tumulus
Tumulus
Scale 208.33 Feet to the Inch
Section AB
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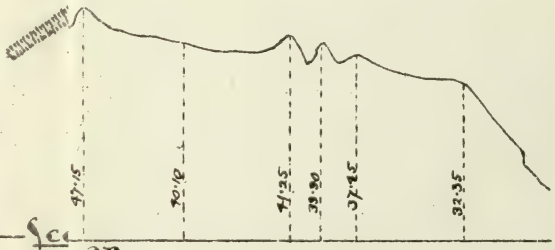
Tumuli

Bwlwarcan Camp

Llangynwyd

1895 Glamorganshire

Tumulus



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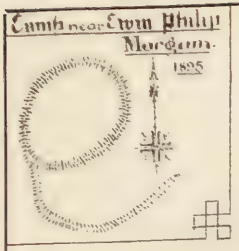
Bridgend. Glam



Bon Mawr
CAMP
Glamorganshire
1895

Scale 208·33 Feet to the Inch

John. L. Lambert.
Bridgend. Glam.

Cambnea

Bon Mawr
CAMP

Glamorganshire

1895

Sc

John. L. Lambert.
Bridgend. Glam.

short way along the mountain side to the westward, in the direction leading to Neath, there yet exists an earthen cross-mound, with extending arms, each 150 lineal feet in length. Does this mark the burial place of the Roman dead, thus interred by order of their general, who here stood as a Christian on the threshold of British Christianity? Early in the fifth century the Emperor Honorius withdrew the legions, and all traces of the Roman conquests passed away, except their camps, their roads, and their residences; but the now Romanised Briton had profited by the teaching of these intelligent workers with the brain, and they now constructed their defences with greater scientific skill—for on the southern side of Mynydd Margam an important trackway ran from southern vale to northern hills, and close by Ton Mawr, its eastern edge was guarded by rows of early intrenchments as before described, and such as Tacitus so forcibly delineates in Ostorius' victory over Caractacus: "They did not encompass the whole or even any "entire side of the mountain in the regular manner—they were works "raised on the mountain side, considerably below the summit." It is a passing thought, born of similitude, and thus worthy of consideration, was this battle fought and won on this spot amidst the Southern Silures? Opposite, on the western edge, there rests a permanent entrenched camp (Ton Mawr) encircled with vallum and fosse on all its sides. Its southern face has for its protection a four-fold ditch and bank, the whole forming a broken outline—two of its sides being straight and the others curved—enclosing an area of 730 feet each way, whilst the inner camp is in a doubly entrenched square of some 320 feet across. Along the roadway, about 2,100 yards in the N.E. direction, is a similar camp (Y Bwlwarcan) of immense size, evidently built at the same period, the outer lines forming an oval 1,000 feet across, with an inner square camp of 300 feet, and a smaller one of 180 feet square, with series of inner works. Here the spade has played a prominent part, for these works could not be turned, and to make a frontal attack would be reckless in the extreme. It seems to have been the whole aim and scope of these camps to bar the southern and northern passes, and between these defences probably dwelt a princely tribe, secure with their herds and flocks, on this semi-boundless grazing plain. Only faint traces of the dwellings of these primitive inhabitants now exist—even these gigantic shelters for armies scores of thousands strong have suffered disintegration by ploughing and the natural deterioration of ages. Peace and quietness reigned until Teutonic invaders came,—the Celtic people called them Saxons,—and these conquering Teutons spoke of their British enemies as Welshmen.

This racial struggle was long and keen, and late in the sixth century the Saxon Crawlin fought his way step by step from the eastern shores of Britain to Western Wales, neither giving nor asking quarter as his conquering heathen hordes drove the Cymry ever westward. In the seventh century the frontier line of Margam was greatly strengthened by the camp of Mynydd-y-castell, guarding a ravine of great importance, thus preventing a south-westerly advance up the valley on Ton Mawr's

defences. This camp is an elongated parallelogram, 1,000 feet in length by 500 feet in width, strongly fortified by deep doubled ditches and steep vallum, and designed without inner works, thus denoting an age when the skilled teachings and military instincts of the Romans were fading from the memory of their constructors, for the combined square and semi-circular camps were giving place to those of a more irregular conception. An increased intelligence is evinced in the selection of strategic positions, which this camp and that of Penycastell, further eastwards, clearly illustrate.

Mynydd-y-castell, blocking an important line of communication, is a fortification erected on a commanding, isolated mound of considerable elevation, the lines of circumvallation being of great strength, with space in the interior to manœuvre for its effectual defence. Such a strong natural position would be untakeable except by surprise or siege and want of food, for behind those formidable intrenchments the Britons would offer a determined resistance to their foes, and their intense feeling of patriotism would have made the struggle one of life or death. From this camp, in a direction due N.E. to the intrenchments at Castell Coch, near Llangwyndd, in a nearly straight line of 3¼ miles, six camps protect the trackway which skirts Mynydd Margam—pathetic evidence of the direful times of those dark centuries when slaughter reigned supreme amidst the shouts of the Teutonic victors and the lamentations of the suffering Welsh. Under their princes they erected yet another bulwark of defiance — the camp of Penycastell—on the elevated tongue of land near Kenfig Hill, in plan similar to Mynydd-y-castell, seven hundred feet in length by two hundred and twenty feet in breadth, and constructed in all probability at the same period. It commands two valleys, and from its earthen ramparts a bird's-eye view of the coast is obtained. Its steep declivities render it impregnable, except on the eastern face, where the traverse and parapet are strongly defensible, resting on sections of Pennant Rock, Carboniferous Limestone and Old Red Sandstone in close juxta-position—a geologic study. Neither by Roman nor by Saxon was the Kymric race in its entirety subdued and isolated from the rest of Britain; their freedom and their language they in part retained.

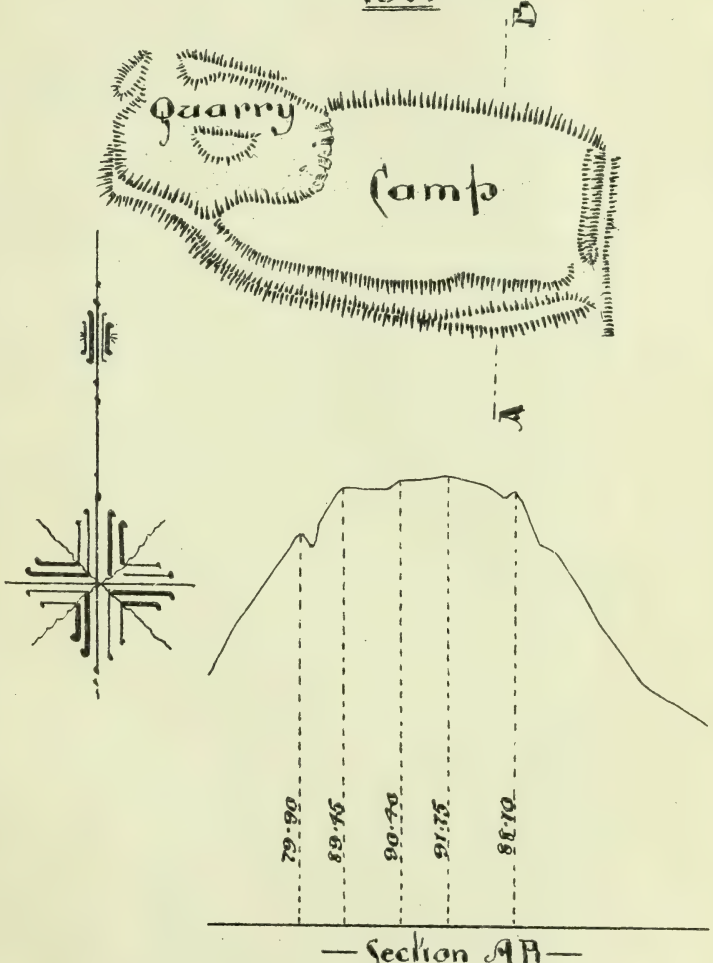
In the ninth century the Scandinavian heathens came; and for the sake of pillage and plunder the Welsh were attacked by roving Danes,—sea rovers who, navigating the Bristol Channel amidst hidden sandbanks, surging tides, and stormy seas, and naming isle and headland as they went, moored their frail craft in Porthcawl creek, and on Stormy down constructed a circular camp of 500 feet diameter, and a smaller one near the Ton Mawr camp.

The embankments have nearly disappeared, caused by the excavations of lime workers on the down, but the tumulus of "Twmpath-y-ddaiar" is yet spared. These Danish axe-armed invaders disappeared, and the ancient earthworks of the early races were succeeded by Norman castles and trained men-at-arms, and the tribal system of the natives found an end.

Pen-y-castell
Camp
Kenfig Hill

Glamorganshire

1895



Section AB

Scale 208·33 Feet to the Inch

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Bridgend. Glam

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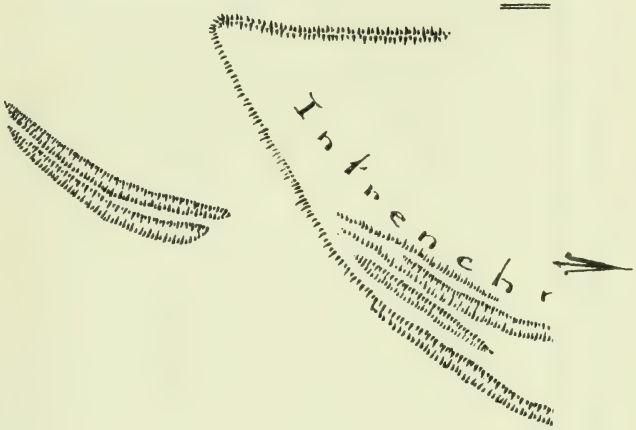
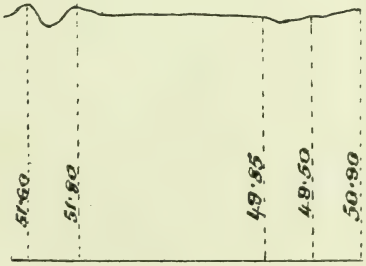


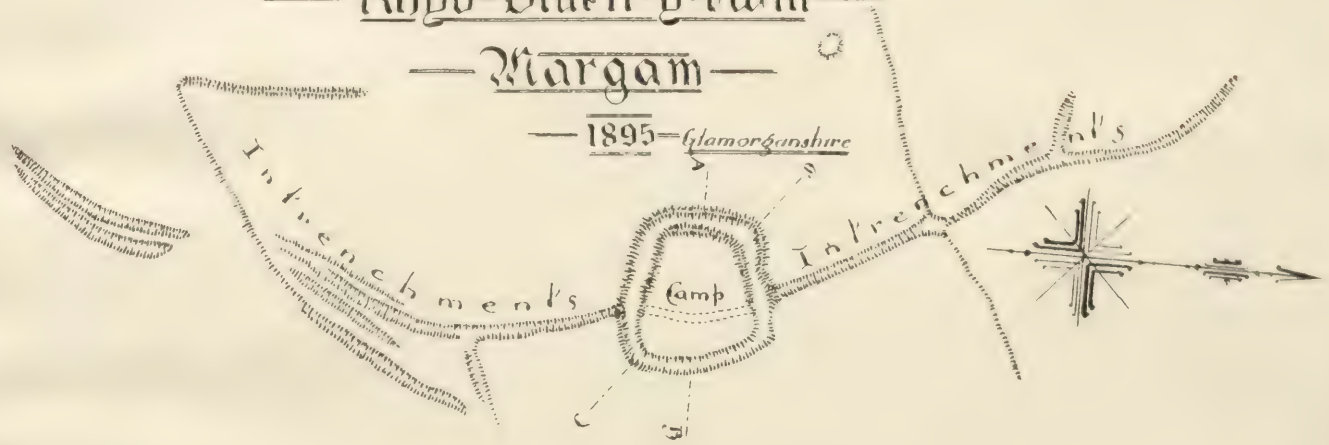


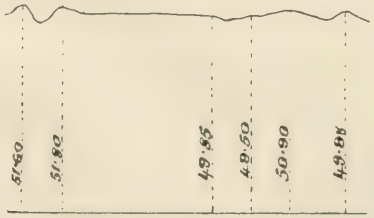
Section AB

Scale of Plan = 208·33 Feet to the I

Scales of Sections { Horizontal 100 Feet to the Vert.
Vertical 40 Feet to the Hd. Glam.

Camp
near
Rhyd-Blaen-y-Cwm
Margam
1895 — Glamorganshire





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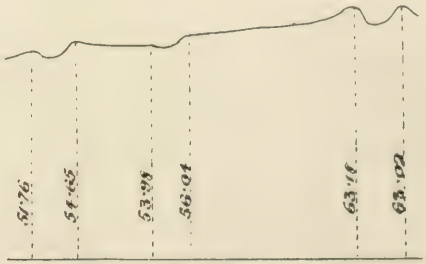

Section CD

Scale of Plan — 208·33 Feet to the Inch

Scales of Sections { Horizontal 100 Feet to the Inch / Vertical 40 Feet to the Inch }

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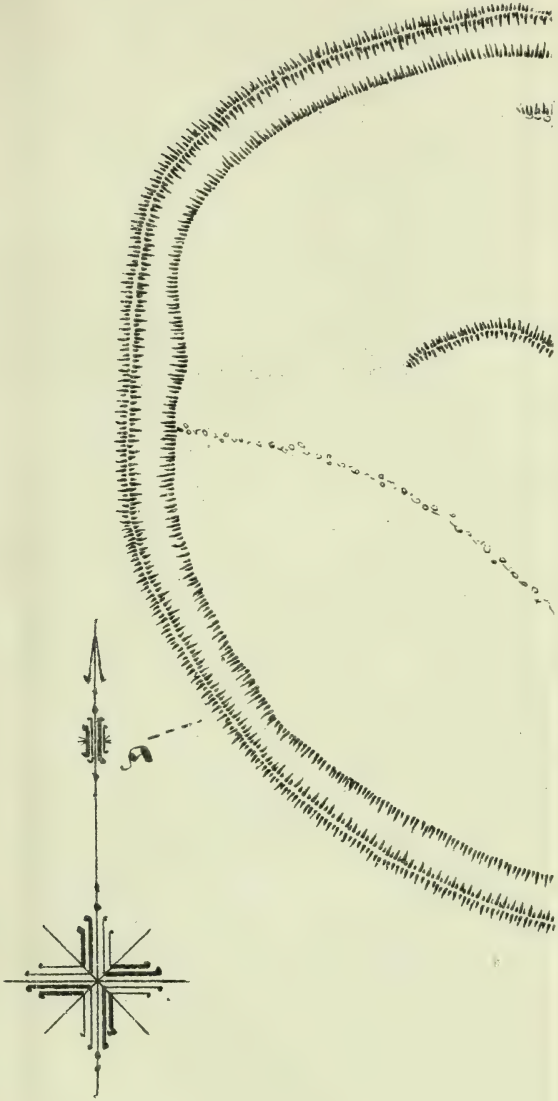
Bridgend. Glam.



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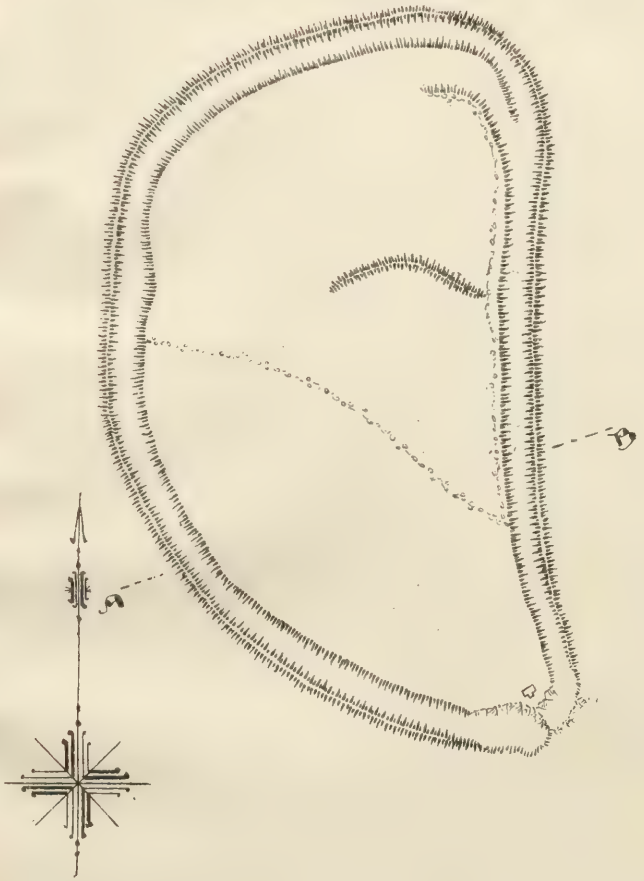
Scale of Plan = 208·33 Feet to Inch.

d. Glam.

Mynydd Castell
Camp
Margam

Glamorganshire

1895

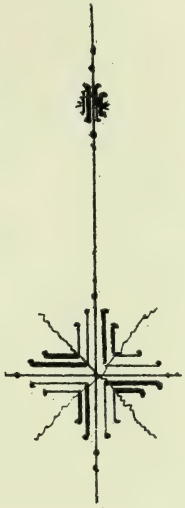


Section A.B

Scales of Section { Horizontal 208.33 Feet to the Inch. / Vertical 40 Feet to the Inch. }

Scale of Plan - 208.33 Feet to the Inch

John. L. Lambert.
Bridgend. Glam.



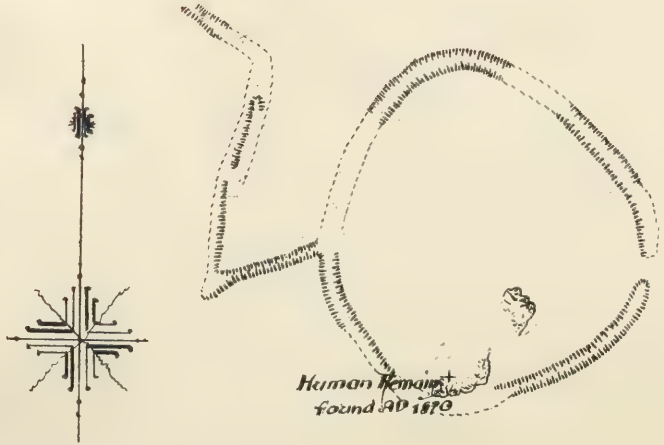
Scale 208·33 Feet to the Inch. Art. Glam.

Stormy Down

CAMP

Glamorganshire

1895



Tumpath-y-ddaiar

Scale 208·33 Feet to the Inch

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Bridgend. Glam.

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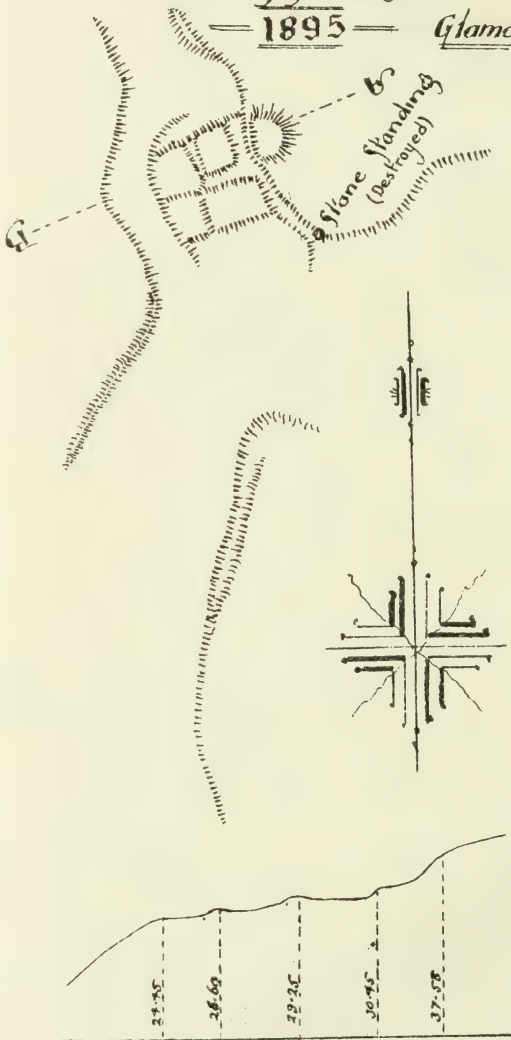
British Fortified Residence

near Maescadlawr

Llangynwyd

1895 — Glamorganshire.



Section A.B.

Scale of Plan 208·33 Feet to the Inch

Scales of Section Horiz 100 Feet to the Inch, Vert 40 Ft. = 1 Inch

The system of these earthen defences unfolds to us the works of profound strategists of their day—a day long past—who sought to stem the tidal inrush of fierce invaders from the east. On the western side of this vast and interesting battle-field these strategists speak not, for the soil has never been disturbed by intrenching tools, except the far distant north-west surface of Mynydd Emroch, near Cwmavon, where a small oblong British camp exists, about 500 feet above sea level, some 350 feet in length by 150 feet in breadth, and known as Penycastell. Nearer east tradition speaks of a furious fight on Mynydd Brombil, a continuation of Mynydd Margam, near the head of the steep gorge of Cwm Geiff, on a field presenting an indented surface and known as Pantycae.

Again, in the near future (after a long interval), history, may repeat itself, and a second Teutonic invasion come, not from the eastern land, but from the western sea, and at a time when England stands in preparedness, with mobilised brigades guarding eastern and southern shores, with fleet in Northern Seas and English Channel held engaged by an overwhelming foe. Then the transports of the enemy may with safety steam out of sight of signallizing headlands to the Atlantic Sea; afterwards, changing course, and running under cover of night's darkness or morning's sulky mists to Caldy's or Mumbles' sheltered roadsteads with army corps intact. Perchance another Von Moltke may have planned the advance of a Teuton host on the metropolis of the world by the direct eastern road, avoiding entanglement in the northern hills with their defiles and swamps. Then will Margam heights, flanking the enemy's advance and commanding both road and rail—with eastern Penycastell, Stormy common, and Newton down sweeping the foes in front—become a British Plevna, open in rear, but secure on both its flanks; checking these invaders of our land, and gaining time for the general of the district to concentrate his massed divisions, and regain the freedom of our country and the safety of our realm.

Amongst mountain fern and heather the party drove down a picturesque ravine, with the delicate aroma of fir-woods wafting by; and along the road past Maes-cadlawr (Meadow-Battle-space), a little to the west of which are the remains of a fortified residence of a Celtic chief, with longitudinal earthen parapets, thrown up for the protection of the inner dwelling. This is comprised of two roughly rectangular and two nearly square compartments, divided off by earthen banks, in the centre of which may be traced circular stone-lined hollows sunk beneath the surface, the whole inner enclosure being of the area of 110 feet each way, with a semi-circular mound raised some six feet above the surface on its eastern side. Around this chieftain's abode, in all likelihood, lay the village of his tribe, and perhaps, a wicker oratory. A few years since there stood on the south-eastern angle an upright stone, of which but a few fragments remain scattered here and there. It was a glacial quartzose sandstone, and, speaking from the indentation still existing in the soil, was probably some

twenty-eight inches by nineteen in size. No trace of Ogham characters or incised lettering can be discerned.

We leave this interesting settlement of very early times and pass on our way the pretty farmstead of Gadlys (Hall of Battle), situated in the ravine low down on our left. The extremely interesting farm buildings which dot hill and valley in this locality are well worthy of careful investigation from an archæological point of view, many of them being of great antiquity. In one of those humble dwellings the second Royal Edward found refuge and concealment for many weeks, early in the fourteenth century, from the pursuit of his revolted subjects encouraged by a faithless wife, and none except the poorest of the Cymric people raised banner, drew sword, and bent bow in his defence. But ahead of our party, as we slowly ascended, shining out bright and clear on the sky-line, came in view Llangynwyd's Church, a glowing beacon deflecting rays of goodwill and charity to far off mountain peaks and vales. Borne on the gentle breeze come sonorous peals of welcome from St. Cynwyd's bells, and from each heart went forth a fervent prayer that never in all time might the vibrating waves of sound from Cambria's ancient churches cease to echo and re-echo amidst her still more ancient hills.

We reach the village of Llangynwyd, part of the ancient manor of "Tir Iarll" (Earl's land), situated in the hundred of Newcastle, the latter being probably both of Saxon origin, and we are here received by Mr. Edward Knox with words of gracious welcome from Miss Talbot, as we enter the threshold of her domain. Escorted by the vicar, the Rev. Stephen Jackson, we stand on hallowed ground, and view what was for scores of years a roofless, ruined church, but now rebuilt, by a woman's Christian heart and thoughtful reverence. Her memory is revered by multitudes of worshippers in churches restored at her sole cost in many mountain solitudes and busy industrial vales; and it is truly said of the late Miss Olive Talbot, "Blessed are thy works."

The church is dedicated to St. Cynwyd, a Welsh saint, and therefore of early foundation, and probably frequently rebuilt, for great veneration has always been attached to consecrated and sacred sites. The south porch is a work of great architectural merit, and fixed to its inner walls are preserved several relics of antiquity—one, a small stone 28in. long, 13in. wide, and 8in. thick, with oblong hollow in centre, and with longitudinal and vertical incised marks, evidently the work of ancient days, caused by the sharpening of warlike instruments and weapons on its surface. Also there is seen a fragment of stone double-moulded, found in the masonry of the 13th century chancel arch. This is very similar to the base of the supposed Roman miliary stone, which rests on the side of Stormy down. We enter the sacred building, and are struck with the careful foresight evoked in its restoration, every feature of its past being carefully preserved. Here is its 13th century chancel arch in all the solidity of its rude workmanship; its tower at the western end of 15th century date is impressive of the honest toil and

St. Cynwyd's Church, Llangynwyd, Glamorganshire.—1895.

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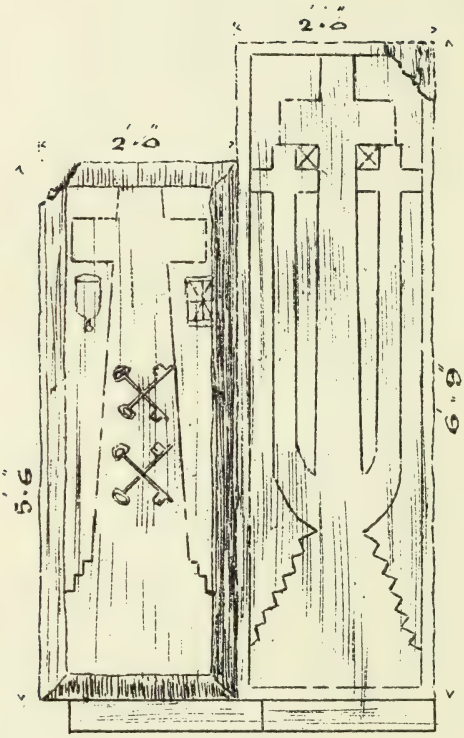


Stones
Llangynwyd Church

honest hands which laboured on these sacred edifices for love and not for gain. On the eastern tower wall rests a stone slab of interest, decorated with an incised cross, chalice, Bible, and double cross keys, the mural memorial of, perhaps, an ecclesiastic of this church. Dating as it does from Henry's reign it is probable that when that whirlwind of his selfish avarice which blew destruction to the monastic establishments of this land rushed over Margam Abbey, confiscating its possessions and lituristic wealth, a key-keeper of this sanctuary, a clerical monk of the establishment found refuge in this peaceful and secluded mountain village, and this stone may perhaps commemorate his decease. In close proximity is a well-preserved three-stemmed Calvary cross. A few of the original church seats, worm-eaten and decayed, still do service in the nave. They are very massive, and made of British oak some three inches in thickness. We reflect and ponder over the scenes of past history, during the five or six centuries of time since they were here placed, and of the heart-searchings of their varied occupants, as generation followed generation of pious worshippers who here heard the preaching of God's Word!

The piscina is close to the altar on a pillar near the southern wall. The communion plate is stamped with double Tudor rose, and the chalice bears the date of A.D. 1567, the vicar at this period being John ap Morgan. The priests' door of the chancel is of the 13th century date, keel moulded in pattern. The registers date from A.D. 1662. The earliest dated stone bears the monogram W.T. 1596 A.D.

In the chancel floor, graven in brass, stand out in mute simplicity words which once more cause us to revert to a past age, and place before our thoughts the chequered feelings of one who has gone before, for here lies the "Maid of Cefn Ydfa," who in A.D. 1725 married, in conformity to parental will, one of high position, but alas to die A.D. 1727 insane and broken-hearted by the affection borne for humble, honest, Will Hopkin, to whom in her early years she pledged her troth. Such is the love of woman. Garlands of fresh flowers laid by the tender hands of the sympathetic villagers have since her interment marked her grave—may it be ever so.

Luncheon was partaken of in the adjacent schoolroom. The Rev. Canon Thompson in feeling words, moved a vote of thanks to Miss Talbot for her courtesy and valued aid so generously afforded to archæologists in the furtherance of their studies of primitive antiquities which abound on her estate. Mr. Knox, in well chosen language, replied, giving expression to Miss Talbot's earnest wish to give every facility to the Society for the careful investigation of the earthworks, intrenchments, and tumuli which girt the hills of her estate and all that pertains to the early history of its inhabitants. He also expressed the hope that the spade in skilful hands might be used, as being the only means by which the habits and works of the early races of men can be studied and revealed. He urged that this search should be promptly commenced before the invading armies of industrious

colliers took possession of the coal strata lying intermixed with and under the Pennant Rock of these hills and all traces of the past consequently disappeared.

We wave adieu to hospitable Llangynwyd, and with cheers of good will from its villagers we proceed to the oval British camp of Castell Coch, 300 feet by 200 feet in area. It is in a secluded spot, and at the side of it runs a stream. The earthworks are well formed, with deep moat and ditch, and, prompted by the strength of its defensive position, the Normans evidently utilized the earlier earthworks and thereon erected a keep, of which but small traces remain. There are records in existence of its early lords. We proceed to camp Bwlwarcan and examine its inner earthen citadels and outer works. In the north-east field there are the vestiges of thirty-eight tumuli, but the ravages of time and the plough have nearly obliterated these works of early man.

Five hundred yards further north, on higher ground, stands another camp, stirrup-shaped, two hundred and twenty feet across. Along a British trackway our President led the way. The ascent was long and wearisome ; but at last he stands by Bodvoc's grave, with cross of bronze suspended from his breast, gazing intently and with great solemnity on that cross, chiselled deep in stone by Christian hands six centuries after the birth of Christ.

On a slight mound of earth, at an altitude of 1,130 feet, stands erect the Bodvoc stone, a connecting link between early and present Christianity, and we read, incised in this block of exceedingly hard sandstone--

BODVOC. HIC. IACIT. FILIUS. CATOTIS. IRNI. PRONEPUS. ETERNALI. VEDOMAVI.	Here lies Bodvoc, son of Catotis, great-grandson of Irnus, in his eternal home.

The letters are in Roman capitals, and are in an excellent state of preservation ; and by compass-bearing face due south, they have proved invaluable as a directive guide in cloudy mists to scores of exhausted travellers over this weird mountain.

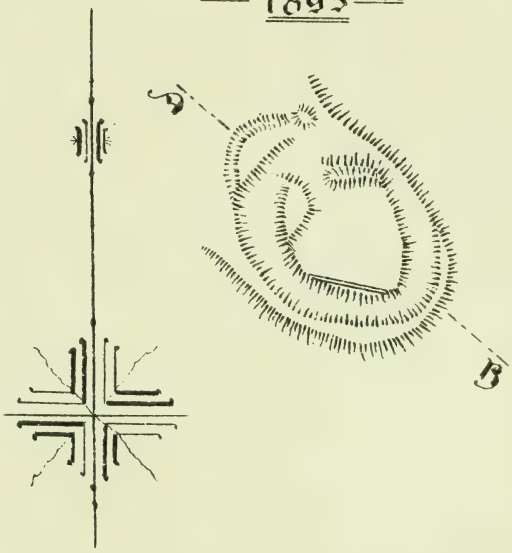
That this sepulchral lapidary inscription commemorates the decease of a Christian is assured by the Greek cross so carefully cut on the top of the stone. No trace in history has discovered the slightest clue as to who Bodvoc was. Perhaps a mighty warrior—perhaps an ecclesiastic—or a British Prince—who can say ? Who was Catos ?—who Irnus ?—An unsolved historic problem it still remains ; but a very early British coin bears Bodvoc's name. We walk due east 160 yards to Tympath Diwlith, a tumulus of one hundred and eighty feet in circumference, and some six feet in height at its apex. Here, surrounded by attentive listeners, the Bardic "Cadrawd," prone on his native soil, read a paper on this traditionally dewless wonder of Glamorgan.

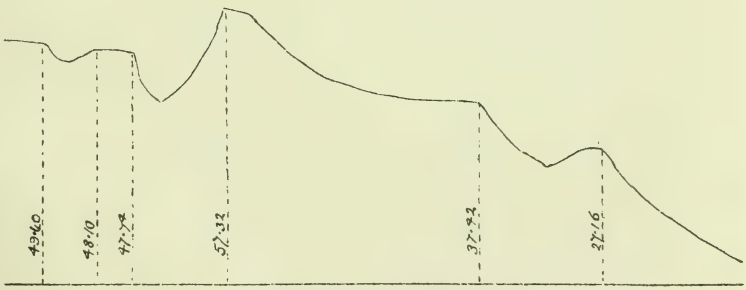
These hills, so rich in mounds of earth and stone, deserve a special study. Who were these mound builders ? To what race did they belong ? Evidently this sepulchral system of remote times prevailed over an

Castell-coch
Camp
Llangynwyd

Glamorganshire

1895





Section AB

Scale of Plan 208·33 Feet to the Inch

Scale of Section { Horizontal 100 Feet to the Inch / Vertical 40 Feet to the Inch }

John. L. Lambert.
Bridgend. Glam.

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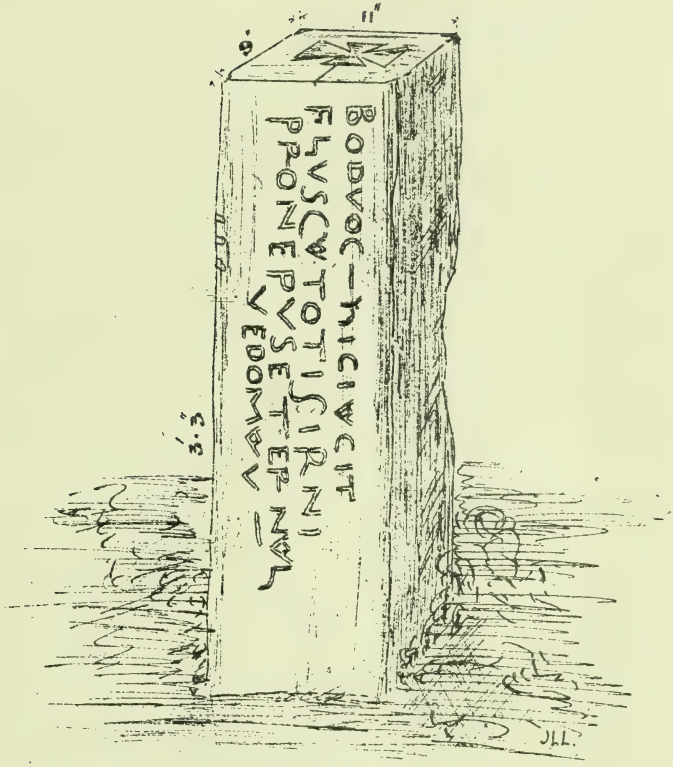

Bodvoc Stone
Mynydd Margam

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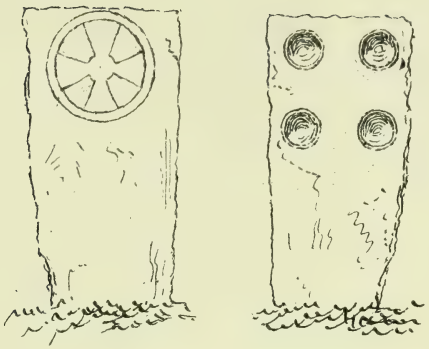
extended period, and covered vast areas of the world's surface, and by long ages preceded Christian times. This tumulus, from the large area covered, is, doubtless, of very early origin, probably of the Stone Age, and a striking contrast to the many other round and chambered tumuli of smaller type, constructed when cremation was the rule in the later Bronze Age. A careful examination would, no doubt, reveal relics of the life of pre-historic times.

Seen from afar, this mound may have been utilized for signalling between the camps in the vicinity, or the Celtic priesthood may have made incantations from its elevated sward, and Druidic auguries, as to the propitious time for fighting battles, may have been here delivered. We ponder over the possibilities of these Pagan times and with absorbing thoughts as to the races which have preceded us, we push onward over mountain streams, ravines, and trackways to Margam's deer-grazed Park.

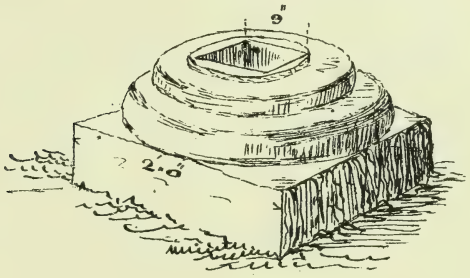
By Miss Talbot's kindness we are privileged to view nature's sylvan groves and landscape, scenes of mountains, vales, and lakes of superb magnificence as we speed along the steep declivities of her park, under spreading branches of lichen-covered oaks, with broad, deeply sinuated leaves in all the glory of their mid-summer green. Many are gnarled with age—giants which have been revered by Celt and Saxon;—others grow luxuriantly in plantations, some 300 years old, planted by Elizabeth's grand old admiral, Sir Robert Mansel, from motives of patriotism, and for his country's welfare, for in that day he could not conceive that the future English war-ship could be built of other material than the hearts of British oaks. We halt by a rushing mountain stream which of old supplied the monastic fish-pond on the left, and invited by our courteous guide, Mr. Edward Knox, and accompanied by our Scottish friend Mr. Muir, the party with many stragglers in the rear ascended the steep escarpments of Mynydd-y-castell. On the summit of this Celtic earthwork the nineteenth century invaders were entranced by the beauty of their surroundings, Mr. Knox pointing out with instructive words the ruins of the early English church (Hen Eglwys) just seen high up amidst a picturesque wood to the westward, on Craig Capel. Some 400 yards in the north-west direction there is a baptismal bath of early English date, whilst under our feet the pinnacles and towers of the princely residence of the Talbots gleamed in the rays of the now fast setting sun. In close contiguity rested the hoary ruins of the Cistercian Abbey of Margam. It is now shorn of its power and its vast possessions, but a portion of its former greatness still exists in the nave and aisles of the parish church dedicated to St. Mary, in which, placed by Miss Talbot's thoughful care, rest securely many of the earliest carved and inscribed stones of Wales. This church is in truth a museum which gives protection to and preserves from destruction the richest gems of Glamorgan's lapidary remains. Under its sacred roof are also monumental effigies of many generations of the Mansels, of great value as examples of the costumes, armour, and vestments of their day, all being sculptured with scrupulous care and minute exactness;

also resting here is the impressively life-like effigy of the late Theodore Mansel Talbot, one who evinced much interest in archæological research, and who was devoted to the preservation of the scattered and rare relics of the primitive people who lived and died on this ancestral estate before the dawn of the historic period. In the ruined Chapter House is now, secure from harm, the piece of chiselled stone referred to at page 59 in part II. of the Transactions, 1892-3, which was discovered buried in the soil on the site of the extinct church at Cae Hen Eglwys. It proved to have early Celtic crosses incised on both its broad faces, the four small circles being of similar design to those of some of the early Cornish crosses. The existence of this sculptured stone tends to prove the great antiquity of this church of St. Cynwyd.

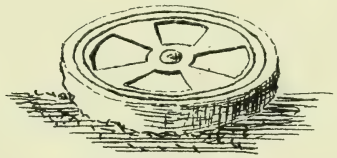
We gaze over the green verdure of fields, and the dark blue water of the inland pools, over sand-dunes, throwing afar their deflected yellowish glint, and beyond all are cloud-shadows in fantastic shapes, reflected on vast areas of the silvery sea. Port Eynon head, on the Gower coast, far out over Swansea Bay, stands forth with its indescribable tints, and, behind it sets with radient splendour, the evening sun. We leave this fairy scene and drive eastward through the park. Waving adieu, with grateful feelings of thanks, to Mr. Knox, we are on the high road for home. To our right, near Eglwysnynydd, by the roadside and unprotected, is the PVMPEIVS-CARANTORIVS and Ogham inscribed stone. To our left, further to the north-east two miles is Capel Trisant (Three Saints)—a circular excavation on the mountain side, stone lined and twenty-three feet in diameter, its north face protected by the mountain slope, but open to the south. This may be the site of an extremely early rude-domed chapel, with a smaller anchorite's cell of similar construction near by. There are many of these circular excavations on Cefn Hirgoed and other mountains in the near neighbourhood which urgently require careful investigation. We rapidly proceed through Pyle and upwards across the down of Stormy. By the roadside is a stone base, probably of a Roman miliary stone (in situ) as another of similar pattern can be seen, nearly buried in the drifting sands near Kenfig, both being on the Roman road (via Julia-Maritima). Through Laleston, passing many other cross bases, we reach Bryntirion, the residence of Mr. R. K. Prichard, who carefully guards a cross of Celtic workmanship, which has every appearance of being of very early date. It is cut on half of a boulder stone, and has never been attached to a supporting shaft. It was found some years since in the walls of an old barn at Laleston. At last Bridgend heaves in sight, and the cry is to the hostelry, for we are all tired and hungry. We visit an interesting house, once the property of the Knight's Hospitallers of St. John, for here exists their curious monogram graven in stone and their heraldic device, the Greek cross and eagle deeply chiselled. The early English arched doorways and its oaken roof all call for inspection. Some records exist of the Hospice of St. John at Newcastle, the name of the parish and hundred and ancient township in which this house stands; and its fame was by grateful travellers spread far and wide.



Inscribed Celtic Cross on a Stone
discovered 1896 A.D on the site of extinct Church
of St Cewydd's ("Cae-yr-hen-Eglwys").
Glamorganshire



Base of Roman Military Stone on line of
the Via Julia Maritima Stormy Down
Glamorganshire. 1895



Celtic worked Cross on Boulder Stone
Brynllirion. Bridgend
1895.

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Heraldic design—Hospice of the Knights Hospitallers of St. John of Jerusalem, Newcastle, Bridgend.—1895.

Monogram—House of the Knights Hospitallers of St. John of Jerusalem, Newcastle, Bridgend.—1895.

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The Hospice of the Knights Hospitallers of St. John of Jerusalem, Newcastle, Bridgend. —A.D. 1895.

Its stones, its walls are hallowed by the greatest of Christian blessings—charity to all mankind. How many wearied, sick and helpless pilgrims have been here relieved history telleth not.

This Brotherhood held ten acres of land in Oxwich (Gower), A.D. 1176; but Elizabeth annexed to the Crown all the property of the order, and thus greatly crippled the good services of this hospitable Brotherhood; although under a Lord Prior, the order still exists at St. John's Gate, Clerkenwell. At the York Hotel the party had some much needed refreshment, and after assimilating the necessary carbon for the generation of sufficient caloric power, proceeded under a full head of steam to Cardiff's Norman town.

The journey is over, but not yet ended, for we have but taken a superficial glance at the actual existing remains of gigantic earthworks, and given but a slight palæographical sketch of the early inscribed and sculptured stones of Margam's archæologically instructive district; but the end will be reached only when these wonders of our hills have been critically examined and their historic truths revealed by a sectional research of each tumulus—each camp—each sculptured stone. Then, and not till then, will our archæologists be worthy of their honoured name in the capital of Wales.

On the Pre-Cambrian and Cambrian Rocks of South Wales.

By HENRY HICKS, M.D., F.R.S., F.G.S.

Introduction.

In responding to the request of your Committee that I should communicate a paper, for publication in your Transactions, upon my work in South Wales, I feel that, to be in any way useful to your members, it should be limited in its scope, therefore I have confined it to an account of those researches amongst the oldest rocks which I have carried on, either alone or in association with others, more or less continuously during the past thirty-two years.

Up to the year 1862 no fossils had been obtained from the Cambrian rocks of South Wales; but in that year, Mr. J. W. Salter, F.G.S., the well-known palæontologist of the Geological Survey, paid a visit to St. David's, and was fortunate enough to discover in the rocks at Porth-y-Rhaw, portions of a gigantic trilobite of the genus *Paradoxides*, which he afterwards named *Paradoxides Davidis*. Through the instrumentality of my relative, the Rev. Professor H. Griffiths, of Liverpool (like myself a native of St. David's), I was placed in communication with Mr. Salter, and in a short time was able, not only to furnish him with better specimens of the *Paradoxides* than he had previously obtained, but also to send him other fossils belonging to several new genera.

In 1863 I communicated a paper to the Liverpool Geological Society, of which Professor Griffiths was then President, on the Lower Lingula flags of St. David's, Pembrokeshire, in which is given a measured plan

and section of the fossiliferous beds, as well as a list of the fossils which we had up to that time discovered, and their order of appearance and distribution in the beds.

Some of the new forms were described and figured by Mr. Salter in a paper communicated to the Geological Society of London, in 1864, and in that paper he states that * "When the imperfect fragments of a great trilobite were discovered by myself in the Lingula flags of St. David's, and brought before the Society in February, 1863 (Quarterly Journal Geological Society, Vol.XIX., p. 275), I had no reason to suppose there was a chance of obtaining more specimens. The occurrence of so conspicuous and characteristic a genus as *Paradoxides* in our primordial zone was, however, worthy of record, though the description was necessarily incomplete. But by the co-operation of Professor Griffiths, of Liverpool, and particularly the zealous examination of the beds by Mr. Henry Hicks, Surgeon at St. David's, we are now in possession of much more abundant and perfect materials. Mr. Hicks' discoveries have really made a large addition to the primordial fauna. It has been, hitherto, a scanty one in Britain, perhaps for the reason only that we have had very little opportunity of working at the formation. And yet, in this favoured spot near St. David's, we have suddenly come upon a collection of new species, and the locality promises many more. We have obtained new genera, all of a primordial character, and among them a new sponge, an organism new to the primordial zone ; for the protozoa have not hitherto been found in strata certainly older than the Lower Llandeilo flags and Caradoc sandstone, with one, perhaps, doubtful exception hereafter mentioned."

In the same paper Mr. Salter also says that he found it necessary to give "an amended description of the large *Paradoxides ;* for there are now the means, through nearly a hundred specimens, of making it complete. These better specimens show the eye to have been more forward than was previously supposed, and supply the great head-spines, the hinder thoracic rings, and the tail, which is of a very remarkable structure, and quite unlike that of any other species of the genus."

From time to time as new organisms were being found, and fresh areas searched, the results were communicated to the British Association for the Advancement of Science, the Geological Society of London, the Geological Magazine, etc.

The first reference to Pre-Cambrian rocks at St. David's was in a communication to the British Association in 1864; but at that time the evidence we had obtained was very incomplete, and it required the work of several subsequent years before we were able to assert positively that rocks of Pre-Cambrian age occurred in that neighbourhood, and also in several other districts in Pembrokeshire.

The Pre-Cambrian Rocks.

These rocks, which are the oldest portions of the crust of the earth exposed to view, can be seen in several areas in Pembrokeshire, and

* Q.J.G.S., Vol. XX., p. 233.

their examination has been the means of affording much valuable information with regard to the physical conditions which prevailed during the Pre-Cambrian period. The results here obtained also stimulated enquiries in other areas in Great Britain and elsewhere, and it soon became possible to trace, with a fair amount of accuracy, the outlines of many Pre-Cambrian areas where they were previously unsuspected. The fragments found in the conglomerates, at the base of the Cambrian, furnished evidence of the condition of the Pre-Cambrian rocks when these shore deposits were laid down, and by tracing the Pre-Cambrian floor itself under these deposits, it was seen that it had a very irregular surface, and that it had previously been subjected to the influence of sub-aerial, as well as of submarine denudation. That this, the oldest land surface known, was covered with a certain amount of vegetation is more than probable; but, unfortunately, up to the present, the character of this vegetation is unknown to us, as hitherto the succeeding deposits have nowhere yielded any evidence of it. The sea surrounding this Pre-Cambrian land contained an abundance of invertebrate life, but we know nothing at present in regard to the terrestrial life of that period. We have, therefore, much yet to learn in connection with these earliest and most fascinating chapters in the world's history. The good results obtained in a few areas during the past 20 years make us hopeful that, as fresh ground is being explored, and there are more workers in the field, much of that which is now a mystery may, ere long, be made clear.

Frequent references to the Pre-Cambrian rocks at St. David's were made, and brief descriptions given in several of our earlier papers; but it was not until the year 1877 that a detailed description of these rocks was published. This was in a paper communicated by me to the Geological Society of London, and Mr. T. Davies, F.G.S., of the British Museum (whose lamented death a few years ago was a great loss to science), furnished notes on the microscopical characters of the rocks. I contributed other papers on these rocks (with notes by Mr. Davies) to the Quarterly Journal of the Geological Society in the years 1878, 1879, and 1884, and another in 1886 with notes by the Rev. Professor Bonney, F.R.S.

As all these rocks had been coloured on the Geological Survey Maps, either as intrusive in the Palæozoic rocks, or as having been altered by the so-called intrusions, it became necessary to work out the petrology with much care, for up to that time no rocks of this character had been described from any Pre-Cambrian areas. This fact necessitated many corrections and additions whilst the work was proceeding. It also led to the abandonment of some theories in regard to metamorphism, which at first influenced some of the conclusions arrived at. At present we hold that the Pre-Cambrian rocks in Pembrokeshire (as also in North Wales) consist very largely of volcanic materials, and of intrusive rocks, belonging to various stages in the Pre-Cambrian period. The Granitoid Gneisses common here, as in other Pre-Cambrian areas in different parts of the world, and formerly supposed to have been

highly metamorphosed sediments, have now been proved to have originally been igneous rocks of a granitic character, which had undergone changes as the results of earth movements, crushings, etc. Other interesting igneous rocks, both of an acid and basic character, also occur in the Pre-Cambrian series. The Granitoid rocks can be best examined south of St. David's at Bryn-y-garn, and on the coast on the east side of Porthlisky Harbour, and the Volcanic series between St. David's and Ramsey Sound. Excellent exposures of the Rhyolites are also to be met with at Roch Castle, near Newgale, and at the Trefgarn rocks, in the gorge of the Cleddy Valley, about halfway between Haverfordwest and Fishguard. In the year 1877 (Q.J.G.S., Vol. XXXIII., p. 230) I proposed to divide the Pre-Cambrian rocks in Pembrokeshire into two series, under the names Dimetian and Pebidian. The former taken from *Dimetia*, the ancient name for the South-Western portion of Wales, and the latter from *Pebidiauc*, the name of the division or hundred in which these rocks mainly occur. Under the name Dimetian were classed the oldest, or crystalline rocks (Granites, Gneiss rocks, etc.), and under the name Pebidian the more distinctly stratified beds (Volcanic breccias, tuffs, and lava flows, also some slates, porcellinites, etc.). These names have since been adopted for similar rocks discovered by us in North Wales, chiefly in the counties of Carnarvon and Anglesea.

The Cambrian Rocks.

Until the discovery by us at St. David's of rocks of older date, the Cambrian series was supposed to be the most ancient to be found in Wales. The name was first used by Prof. Sedgwick, when working in North Wales, and the term is now almost universally adopted for these older rocks wherever they are found. The Geological Surveyors have applied it in too restricted a sense to the oldest only of these sediments. The limit which I shall here adopt is the one used by Mr. Salter and myself in our papers, and subsequently adopted by Sir C. Lyell and by the majority of the Geologists of the present day. Wherever these sediments are found in this country reposing upon older rocks they are unconformable to the latter, and mark one of the great dividing lines in Geological chronology. There are, we know, many lines showing slight or local physical changes in the succession; but at the base of the Cambrian we recognise evidences of wide-spread disturbances which affected very large portions of the crust of the globe. Formerly, and up to quite recent years, it was usual to divide the Cambrian into two main series, and this was the classification adopted in most of our papers. Of late years, however, it has become the custom to make three main divisions, under the names Lower, Middle, and Upper, and these portions are usually sub-divided by local names. As this paper relates only to South Wales, I shall give those local names which have been adopted in our papers when describing these rocks in Pembrokeshire.

The Lower Cambrian, called at St. David's the Caerfai Group, from Caerfai, a harbour on the coast south of St. David's, contains the earliest evidences of life known, and for some years after they were discovered no rocks of equal antiquity had yielded undoubted traces of organisms in any part of the world. More recently, however, fossils have been discovered in other areas in Britain and abroad in rocks of the same age and yielding organisms of like nature. The first announcement of the discovery of fossils in these basement beds of the Cambrian was made by me in a paper to the British Association in 1868. There I stated that henceforth these rocks must not, as hitherto, be classed as "the so-called sterile bases of the fossiliferous rocks, but as a highly important and interesting formation, possessing imperishable monuments of almost the earliest states of life known. These discoveries, along with that of the *Eozoon* in the Laurentian rocks, lead the mind to anticipate the more than probable fact that wherever sedimentary rocks occur, it matters not how deep a position they occupy in the series of deposits, some evidences of former life are likely to be present." Figures and descriptions of these, and of some fossils found in the succeeding beds were given by me in the Quarterly Journal of the Geological Society in 1871.

The most characteristic genus amongst the trilobites in these lowest beds is *Olenellus*, of which fragments only have been as yet discovered at St. David's. Professor Lapworth, however, has found very good specimens in Shropshire, and the Geological Surveyors more recently in the north-west of Scotland. It also occurs on the same stratigraphical horizon in Scandinavia, Russia, and America.

The Middle Cambrian is now divided into two groups, under the names Solva and Menevian, and is characterized by having numerous life zones in which species of the genus *Paradoxides* occur. The name Solva Group was given by me to the lower beds about the year 1881; but the term Menevian was used by Mr. Salter and myself as early as the year 1865. At that time no fossils had been discovered in the underlying beds, and it was not until an important fauna had been obtained from the beds that I decided to class them under the name Solva Group. In these beds have been found trilobites belonging to the genera *Plutonides* (formerly *Plutonia*), *Paradoxides*, *Conocoryphe*, and *Microdiscus*, and the beds are exposed in good sections on each side of Solva Harbour, and at other points on the north coast of St. Bride's Bay.

The beds at Porth-y-Rhaw where Mr. Salter first found *Paradoxides* are classed with the Menevian Group, and are now known to contain a very rich fauna, including many new genera and species of trilobites and some bivalve crustaceans, brachiopods, pteropods, gasteropods, sponges and cystideans. The researches at St. David's have therefore not only shown that fossils occur in much older rocks than had previously been suspected; but also have added very greatly to the fauna of the Cambrian rocks. The upper Cambrian is divided at St. David's into the Lingula flags and Tremadoc Groups. The Lingula

flags have not yielded as rich a fauna in Pembrokeshire as in North Wales; but the Tremadoc Group has given us many new fossils, and contains a very rich fauna. The most characteristic trilobites in the Lingula flags are species of the genus *Olenus*, but some of the beds are crowded with the well-known brachiopod *Lingulella Davisii* (first found by Mr. E. Davis in North Wales). These beds are exposed at Whitesand Bay, and St. Bride's Bay (north side); also near Trefgarn Bridge, where Mr. T. Roberts, F.G.S., and Mr. J. E. Marr, F.R.S., obtained specimens of *Olenus spinulosus*, etc. It is in the Tremadoc rocks at St. David's, that we first meet, in the succession, with true encrinites, starfish, cephalopods, and lamellibranchs. The beds are well exposed at Ramsey Island, near St. David's, and inland at Tremaenhire, etc.

The Tremadoc rocks, which we place at the top of the Cambrian, are followed without any marked break at St. David's by the Arenig rocks (the lowest beds in the Ordovician formation) and these have yielded in the neighbourhood of St. David's a very rich and interesting Graptolite fauna. The faunas of the Tremadoc and of the Arenig Groups were described in papers by Profesor Lapworth, Mr. Hopkinson, and myself in the Quarterly Journal of the Geological Society in the years 1873 and 1875.

This attempted summary of work done in Pembrokeshire can only be considered as an imperfect sketch, and is written mainly in the hope that it might tempt some of the Members of the Cardiff Natural History Society to visit areas proved to be so full of Geological interest, and where possibly many important results may yet be obtained to reward an industrious explorer.

Biological and Geological Section.

REPORT FOR SESSION 1894-5.

COMMITTEE:

The PRESIDENT and HON. SECRETARY of the C.N.S. *(ex-officio).*

President: T. H. THOMAS, R.C.A.

P. RHYS GRIFFITHS, M.B., A. PETTIGREW, J. STORRIE, and W. N. PARKER, PH.D. (Hon. Sec.).

THE number of members on the books is at present 47.

During the session there have been seven Ordinary Meetings (with an average attendance of 16·5) in addition to the Annual Meeting.

The following papers have been read during the session :—

1884.

Nov. 1st.—F. T. HOWARD, B.A.—"The Cardiff Underground-water Circulation."*

" " A. H. TROW, B.Sc.—"Notes on visits to Local Ponds." (The organisms described included *Volvox globator* and *Pandorina morum).*

Dec. 6th.—J. J. NEALE—"A holiday on St. George's Island."

" " W. N. PARKER, PH.D.—Exhibition of and remarks on some specimens of the so-called "Vegetable Caterpillar," of New Zealand, recently presented to the Museum by Dr. Taylor.

" 20th.—W. W. PETTIGREW—"An account of the Botanical Garden in Roath Park."*

1885.

Jan. 17th.—F. T. HOWARD, B.A.—"On the Geology of Barry Island."*

" " J. STORRIE—"On Glacial Boulders found in the Pencoed Terra-cotta Works' Claypit."

Feb. 21st.—W. O'CONNOR—"On several Fossils, including a 'Spider' *(Eophrynus)* from the 9ft. coal seam at Ty'nybedw, Rhondda Valley."*

" " J. STORRIE—"Remarks upon some supposed Coprolite Sections."

" " F. T. HOWARD, B.A.—"Manganese Ore of the Cardiff District."

" " T. W. PROGER—"Remarks on a Sanderling *(Calidrys arenaria)* recently killed at Porthcawl, and on a Bewick's Swan killed near Taff's Well."

" " C. M. THOMPSON, M.A., D.Sc. — "Remarks upon the effects of the recent Frost in the Neath Valley."*

March 21st—R. DRANE, F.L.S.—"The Hare in Captivity."*

" " A. H. TROW, B.Sc.—"On a new record for the Society's District *(Isoetes echinospora)* and other plants in the neighbourhood of Llyn Fawr."

" " T. H. THOMAS, R.C.A.—"Note on Gower Plants."

May 2nd—J. B. HAYCRAFT, M.D., D.Sc. — "The rôle of Sex in Evolution."

In addition to the specimens shown to illustrate the above papers, the following exhibits may be mentioned:—

By T. H. THOMAS, R.C.A.—Various water-colour sketches; a chrysalis attacked by *Cordiceps;* variety of oak-leaf.

By C. T. VACHELL, M.D.—Dried plants from Cornwall.

By F. T. HOWARD, B.A.—Specimens of celestine from Barry Island; sections of South Wales limestones.

By A. H. TROW and A. H. DAWE—Microscopical sections of *Corallina officinalis.*

By J. STORRIE—Lepidophyllum.

By W. W. PETTIGREW—Drawings of Alpine plants.

By R. DRANE, F.L.S.—Variety of the long-tailed Field Mouse, or Wood Mouse (?); variety of the common daisy in which the ligulate rays were reduced or absent; procumbent variety of the Broom; a living Manx Shearwater.

By J. J. NEALE—*Centrina salviani*, recently caught in the Bay of Biscay; *Cancer pagurus* with a branched chela; specimen of coral recently dredged up; *Cypripedium spectabile* from Sir David's Field.

By J. W. PROGER—Eggs of the Kingfisher and Goldfinch.

By W. N. PARKER—Living specimens of *Lacerta viridis.*

* Those papers marked with an asterisk have already appeared in the Society's Transactions.

In response to a resolution passed on December 6th, the Free Library Committee have decided to purchase in the course of the year a number of Botanical works a list of which was submitted to them by the section, and also to give every facility to students for the use of the books in conjunction with instruments in the new building.

The accounts show a balance in hand of £12 5s. 6d.

W. N. PARKER.

University College, Cardiff,
June 22nd, 1895.

On the Effects of the Recent Frost in the Neath Valley.

By C. M. THOMPSON, M.A., D.Sc.

Read before the Biological and Geological Section on February 21st, 1895.

WISHING to see the waterfalls of the Neath Valleys during a hard frost, I made two expeditions to the district, on February 10th and February 16th, 1895. As far as could be judged from the portion of the Little Neath which was visited on both occasions, no great change in general appearance took place between these dates, though the quantity of ice was undoubtedly greater on February 16th.

The Hepste, Mellte, and Little Neath streams were, in the main, unfrozen, and a fair volume of water was passing over the falls, which were beautifully draped with icicles. We crossed the Hepste by going under the fall, as usual, but found that some step-cutting was desirable, as the rock was thickly covered with ice. We passed behind one complete ice pillar.

The Perddyn was almost entirely frozen over above the junction with the Little Neath, so that we walked a good part of the way between the Scwd Gladys and Scwd Einon Gam on the ice, right up the stream. This made Scwd Einon Gam much easier to reach than usual. The two falls were frozen solid from top to bottom, and by a little step-cutting, we got nearly half way up the Scwd Gladys and almost one-third of the way up Scwd Einon Gam. In both cases, the upper portion of the fall was all ice, while, at the bottom, there was an accumulation of drift snow, thickly iced over on the surface, forming an inclined plane leading up to the ice pillar above. We got right round behind the ice pillar of the Scwd Gladys, but the ice of Scwd Einon Gam was attached to the rock.

The remarkable difference between the Perddyn and the other streams seemed to me to be accounted for by the lesser volume of water. It was however suggested by Mr. O'Connor that the different aspect of the valleys had much to do with it. The Perddyn runs nearly east and west, and the valley, and especially the falls, are in shade practically the whole day. The other streams, running nearly north and south, get the whole of the mid-day sun. On reflection, this appears to me to be the main cause of the difference. We noticed, on February 16th, a sunny day, that there was a distinct change of temperature on passing from the Little Neath to the Perddyn Valley.

All over the district the immense masses of ice, formed by what are usually mere trickles of water, were very noticeable. These masses, and most of the icicles seen in many places on the rocky sides of the valleys, were usually not transparent; the ice was full of minute air bubbles, and looked dazzlingly white in the sunshine. The icicles produced by the streams themselves were usually more transparent, and the ice pillar of the Scwd Gladys, when seen from behind, showed the characteristic greenish-blue colour of ice in the mass.

The Hare in Captivity.

By R. DRANE, F.L.S.

(Read before the Biological and Geological Section.)

I HOPE no one will anticipate in what follows a flood of new light upon the natural history of the hare, for, in that case, he is foredoomed to disappointment. The only value attaching to what I have to say will consist in its being the narrative of a close personal intimacy with a creature so extremely nervous and timid that I find existing a very general belief that the hare is simply untameable; although there is the record of Cowper's hares. Of the one he had some ten years, he says that it was—

> "The surliest of his kind,
> Who, nursed with tender care,
> And to domestic bounds confined,
> Was still a wild Jack hare.
> Though duly from my hand he took
> His pittance every night,
> He did it with a jealous look,
> And when he could would bite."

Well, that is Cowper's experience, and it is very different from my own; perhaps because my hare is a haress, and the gentlest and most affectionate of her sex or race. There is another authority higher than Cowper: "Every kind of beasts and of birds, and of serpents and things in the sea is tamed, and hath been tamed of mankind" (James iii. 7), *e.g.*, oysters and electric eels; and I have myself seen a lady call swallows from the open air, and as soon as they heard her voice they would come to her hand. (This was Mrs. John, of Llantrisant.) On the 1st of August, 1894, a friend sent me a little hare, which the gardener had caught in the asparagus bed. It was not then independent of its mother, and I suckled it by dipping my finger in milk and putting it to its nose. This very tedious process was followed for three or four days. Then it would take the milk from a small silver

teaspoon ; next it took it from an egg cup, and ultimately drank it from a saucer, to the extent of four to eight ounces a day, which it has continued to do ever since. For three weeks it had nothing but milk ; then it began to take all manner of vegetable food, for, locust-like, it would eat almost any green thing except, perhaps, that which one would expect it to eat as a matter of course. Everybody knows what fearful injury hares inflict upon the farmer by eating his turnips. I naturally assumed that in turnips I should find a cheap and convenient food, but oddly enough, it would not eat any kind of turnip foliage or stem, but it was very fond of roses. It would follow me about the room and jump upon my lap in its eager desire for a fresh, half-opened tea rose. I have never heard a gardener lay *this* to the charge of the hare, but any one of them will tell you how destructive the creature is in his domain. He cannot rear a dahlia, or supply the house with parsley ; and as for carnations, their culture is impossible by reason of the hare. I gave my hare the foliage of dahlia, carnation, and parsley, and it would touch none of these while supplied with clover grass and laburnum leaves. Perhaps my hare was eccentric ; for instance, it would eat cinders "to scour its maw." "Birds of a feather flock together," you know, and I hope no one will venture to question the verity or the wisdom of a proverb. Here is a hare eating roses and cinders, and here is a man who will never again eat a hare. I have to do with facts as I know them, and in their consideration will have nothing to do with interested accusations unconfirmed by personal observation. Meantime let it never be forgotten that general deduction from individual experience is perilously akin to error. I am speaking only of one hare, my hare, who has been convicted of eccentricity. (Some months after this paper was read to the Biological Section my hare died. After some months of "widowhood" I obtained another, which I still have. In many respects their habits are identical, in others dissimilar, so that if I were one observer and myself another, our recorded observations would not wholly coincide.)

My method was to become intimate with my hare, to form my own conclusions, and make my own guesses ; then by reading and inquiry to learn how far they were in accord or discord with those of other observers. One of my first errors was a belief that the hare sleeps with its eyes open, for by no artifice or arrangement could I catch my hare with closed eyes. That was because we had not grown sufficiently intimate to lay aside our "society manners," but now my hare will sleep, and sleeping dream, with closed eyes, not only in the room where I am, but on my lap—nay, even in bed with me, for where I am the hare likes to be, if there is no intruder. Just like ourselves this thing will dream—

> "Which never heard the sanguinary yell
> Of cruel man exulting in her woes,
> Owing his pleasure to another's pain,
> Feeding on sobs and dying shrieks
> Of harmless nature, dumb, but yet endued
> With eloquence of agonies."

It will dream of the freedom it has never known. Dream when it is most actively awake, and pretend that it is pursued by some dog or other swift-footed enemy; taring about as if mad, and practising with marvellous skill and celerity the art of "doubling" in a space no larger than my bed. Is not that unity of nature here suggested, which makes us all of one family? For no one truth can be inconsistent with another. That is a law that lies at the very foundation of mental confidence and peace, and happy is he who knows it. But, lest you think me hare-brained, I must return to the more obvious facts of my story. This delicately-clean, odourless, and elegant creature has one very unpleasing habit. It eats its own dung even when supplied with abundance of acceptable and favourite food. This fact, for fact it positively is, again and again verified by incredulous and therefore close observation, opens up the question whether or not the hare chews the cud. "And the hare because he cheweth the cud but divideth not the hoof he is unclean to you." (Levit. xi. 6.) In accordance with my method I had made up my mind on this point before I consulted men or books, so as to have a check upon hasty conclusions. I asked a friend to whom field sports are one of the primary conditions of manly enjoyment—"Does the hare chew the cud?" His answer came with that nearly-contemptuous assurance which I have learned to distrust as one of the most infallible signs of untrustworthy opinion. He said, "Yes, I have seen it dozens of times!" My own belief is that not only does the hare never chew the cud, but that it cannot. The hare has a habit when at rest, as when sitting in its forn, of grinding its teeth, probably to keep them in order. May not this be the origin of the assumption that it is chewing the cud? What seems really to occur is this: The creature is essentially nocturnal, feeding mainly between 7 p.m. and 7 a.m., chiefly from 9 to 12. It then fills its stomach pack-full, and keeps it full while partial digestion proceeds rapidly; the half-digested food passes down a long, narrow canal, and enters a kind of second stomach; when both are replete it ceases eating, retires some distance from its feeding ground, and spends the major part of the day in perfect quiescence, digesting perfectly this store of food. The process is automatic, and as perfectly beyond the creature's control as it is in ourselves. During this period certain portions of food in the form of imperfectly-exhausted, soft, mucilaginous pellets are extruded from time to time, and received by the animal directly into its mouth upon their exclusion from the rectum; they are swallowed without anything deserving to be called mastication—a movement or two of the jaws—and passed a second time through its digestive canal. This continues to go on until, I imagine, the whole of the food has thus passed through, and I think it is not till then that the pellets of the ordinary dung assume their ultimate form, size, and consistence—that is, hard and almost perfectly dessicated. During all this period the creature does not excrete any ordinary dung. The excretory functions are actively resumed in the evening, and continued through the night. I made a cold aqueous solution of some of these soft pellets, and divided

the clear, filtered product into two parts. To one of these I added the iodine test for starch, but it gave no reaction. To the other I added some solution of starch, and kept the mixture at 98° Fahrenheit for two hours. On applying the same iodine test there was no reaction, showing that they retained sufficient of the digestive ferment to destroy the added starch. This I take to prove that these soft pellets are not the ultimate product of the digestive process. A similar experiment made with ordinary hard pellets gave no reaction for starch. This seems to show that the second passage of the food through the digestive system is part of nature's law, and necessary for her purposes. I must here tell you that Professor Haycraft does not think the experiments conclusive, nor my deduction correct. That may be so, but if it is I should like a reason given me for the undoubted second passage of the food through the hare's digestive system. I find a little difficulty in the way of explanation, accordant with my own view, in the fact that it is not these soft pellets only which the creature consumes, for it undoubtedly eats also, to a limited extent, the perfectly digested and dessicated pellets of its ordinary dung. Here I must leave the question as to whether or not the hare chews the cud, for I have not the capacity to determine it. It may depend upon the definition given to "chewing the cud," which I take to mean a return of the food from the first stomach to the mouth for re-mastication, which return does not take place in the hare. The result may be the same though the process be different—a kind of inverted method.

The next question is whether or not the hare is a burrowing animal. The opinion held by those familiar with and devoted to field sports is that it is not. I hold the opposite view, because my hare does habitually burrow every day. I discovered this by accident, and in order to explain I must admit you to the innermost privacy of those relationships which exist between me and my hare.

During the day the creature is quiescent and scarcely moves, and it does not excrete, so that, consulting its instincts and providing for its habits, it is perfectly inoffensive, and it is allowed to have the run of the house during the night; the staircase and corridors, my study and bedroom are free to it from 9 p.m. to 8 a.m., and within these limits it does as it likes. It likes to be with me, and delights to jump upon the bed, over and under, and upon it again and again, and I have become so fond of it and accustomed to it that it does not disturb me at all. It will almost every morning, when its period of nocturnal activity ceases, get under the bedclothes to enjoy the warmth, and then it will wake me by burrowing furiously; it tears away at imaginary excavations, and throws out imaginary earth precisely as a rabbit does in its real work, "washing its hands with invisible soap in imperceptible water." In these imaginary burrowings it meets with imaginary roots or other obstructions which it bites through. That in prosaic English means just so many holes in the sheet, but the creature is so loveable that I would much rather have half a hare than a whole sheet. This burrowing seems to me an instinctive harking back to that remote

period in this creature's evolution when it lived in holes, as its congeners still do. Of this assumption there are some interesting confirmative indications. There is but one genus—Lepus—in this order of animal, and there is one of its members (the Lepus hispidus) which still burrows, although it is the only hare which still retains this habit. Professor Thompson informs me that in Australasia the common rabbit is beginning to abandon its burrows, and produce its young in the open as the hare does with us. Then the hare has a white "scut," like the rabbit and certain deer, which white "scut," Mr Thomas considers, serves to direct their young in the night, and enable them to follow their parents to a place of safety. It also strikes the ground when alarmed with its hind feet, as rabbits do, to give warning to their fellows on the surface and under it, of approaching danger. The next point is that almost all rodents produce blind and naked young, while the young hare is furred, can see, and run almost as soon as born. Is the Australasian rabbit now on the way to the production of clothed and seeing young? If so, what a magnificent opportunity the now aristocratic hare, which will not associate with its inferior congener, will have of snubbing these parvenus with the stoney stare of hereditary superiority. The retention of the white "scut" by the hare is a distinct disadvantage, for instead of directing its young, which it does not do, it serves to enable the greyhound to follow it, for this dog hunts by sight and not scent. But if it be a retention, and a disadvantageous one, kind nature has given such wonderful compensation in speed, colour, open-eyed and furred young, that one wants to live on and see when and how this detrimental white "scut" shall be suppressed, and whether the rabbits of the Antipodes will retain it when they have given up their plebeian habits of living in holes, and producing naked young like common rats.

The hare has a habit of panting under conditions of enjoyment—that is, as a pleasure, and not as the consequence of fear or extreme exertion. During this panting the respiration is astonishingly rapid, and exactly resembles the puffing of a locomotive engine when moving at, say, 30 miles an hour, and heard at a distance in the stillness of the night. This is a statement which will look like a fancy or figure of speech, but if the conditions are remembered it will be found pretty accurate—a train at a distance, moving at 30 miles an hour in the stillness of night. Now an engine with a six-foot driving wheel, moving at 30 miles an hour, will give 586 throbs or puffs per minute. The hare's normal rate of respiration I take about 40 per minute, which can be easily counted, but counting is quite impossible when it pants, and though I do not mean to suggest that it then breathes 586 times a minute, I do mean to say that the panting is marvellously like that of an engine, breathing at that rate. The rate of respiration is, however, not the most interesting point in this habit of the hare, for whereas the dog pants to cool itself, the hare pants, apparently, to warm itself, for its natural temperature, which is about 98°, rises in a few minutes to 106°. This I have ascertained on several occasions by a good clinical

thermometer held under its arm-pit. Here again I wish to say that Professor Haycraft "doubts my facts," and he will not admit that I can take the creature's temperature correctly except per rectum. This may be so, and such criticism is just what is wanted to elicit the truth, but as I could not take the temperature in the manner suggested, I repeated the experiment in the original way, and the thermometer stood at 106° in 15 minutes while I was nursing the creature, and I do not think anyone would assume that the 106 represented my own temperature and not that of the hare. That this habit is pleasureable and produces a high temperature must I think be admitted, and if this is true the increase of temperature must be due to the rapid oxidation of the products of digestion, and not to the waste of tissue which would result from extreme exertion, as when running before hounds. Here again I am very conscious of my own incapacity, and must leave the explanation to the physiologist. All that I can do is to record my repeated observations that the hare pants with pleasure when there is no excitement or cause for fear, and that the panting produces a remarkable and very rapid rise of temperature.

I have referred to the habit the hare has of "grinding its teeth." This is very probably an essential point in its economy, which may be thus explained. Its incisor teeth, two in each jaw (disregarding the two upper elementary teeth), are continually growing, and the growth takes place at such a curve that, if nothing interfered with it, these teeth would be so developed as to form a four-barred grill in front of its mouth, and ultimately the two lower ones would actually pierce the skull, if death, by starvation, did not terminate the creature's misery. The enamel of these teeth is extremely hard and thick on their outer surface, while it is very thin upon the inner one. Their points must meet exactly, for if they do not, but pass each other, there is nothing so to check their continuous growth as to prevent the above disablement, and I think the grinding of its teeth during its repose is the hare's method of keeping the cutting edges of its incisors in working order. Some years ago I had a rabbit brought me whose incisors had grown in the way I have described, so as to starve the creature by forming a grill over its mouth. This I had stuffed and presented to the Museum, and hoped to have had it here to-night, to show you the consequence of a hare not keeping its teeth in order, but on application at the Museum I found it had been thrown out as moth-eaten and useless.

This creature is a capable and spontaneous swimmer, which is rather surprising when the extreme narrowness of its fore limbs is considered; but on one occasion, walking beside the Taff river when it was in full flood from recent rains, I saw a hare quite deliberately, and not under the compelling influence of fear, excitement, or necessity, go into the water and swim across the rapid stream in such a way as to show that it had a correct knowledge of the force and effect of its current. It landed on the other side, and shook itself in a matter-of-course sort of way, quite as if such passages were ordinary occurrences—and they are.

I have seen another hare cross a stream some eight or ten feet wide, but that is quite a different thing from swimming a broad and rapid stream like the Taff after much rain, rushing down at the rate of three or four miles an hour, for I had to walk very quickly to keep pace with a piece of floating wood. Mr. Neale is familiar with an island off the Cornish coast on which were many hares. These hares disappeared completely and somewhat suddenly, and I have no doubt at all but that they swam across to the mainland, reached by rowing in about 20 minutes. (I have since been Mr. Neale's guest on this island, and I consider the assumption justified.)

The hare's eye is worth some study. Generally speaking it is an uninteresting, hard eye, well described by Zola, with "A blank and frigid stare which does not seem to see," "An ever haunting absent look as of one whom her sufferings overwhelmed." Its iris does not contract as in the cat's and hawk's eye, giving great variety of expression, but it glows like those of the Felidæ. A friend of mine had a hare confined for about a year, and which lived on such vegetables as the gardener gave it, but it was never *seen* to eat, and it never had anything to drink. It was under no human influence, except a fixed dread and suspicion of man. The expression of its eye was in accord with its condition, and showed the pupil with its frigid stare surrounded by a white circle of the conjunctiva. It was a hideous expression of chronic alarm and suspicion, so I do not think anyone could expatiate upon the beauty of the hare's eye; and yet there are differences. My hare has never shown that white-encircled stare. Its eye is not beautiful, but it is quite capable of expressing great variety of feeling—joy, suspicion, fear, affection; sometimes it actually smiles. Its vision, well suited for most of its purposes, is in some respects strangely defective. It usually seems incapable of seeing straight in front of it, for I have had a hare in the open field run between my feet when I was standing astride watching a stoat; and I have known my captive hare run along the corridor and knock its head against a door at the end which happened, contrary to custom, to be closed. This would seem to be due to the absence of the stereoscopic effect of eyes set in front of the head, and not on its opposite sides; but this again is a question for the physiologist or optician. There is one compensatory provision for this assumed absence of stereoscopic projection in the hare's vision, and that is in the use it makes of its whiskers as organs of touch and measurement, for I have seen my hare repeatedly push a door open till it was just wide enough to admit the passage of its head without its whiskers touching on either side. It will pass its head in and out several times, as if to make quite sure; then it will dart through the opening thus measured with agility and precision.

Some of the attitudes of the hare are very striking and bewitchingly graceful. It will sometimes lie at full length on its side, with its head only erect, its hind legs stretched out to their full length. In this position its white underside, otherwise but rarely seen, is very conspicuous, and as the back may not then be visible, the creature looks

mainly pure white, with *blue* or French grey ears, for the inside of the ear is very blue at times. The conception of a blue and white hare seems rather imaginative than real. It will romp and roll itself with infinite delight and sprightliness on a clean, white counterpane or table-cloth. Sometimes it will sit with its hind legs extended forward, so that the hind feet are in advance of the nose, and the fore feet under the nose, when it looks as if it had four fore feet and no hind ones. Again, it will draw back its hind feet and extend its fore ones to their fullest length, and then its head seems to rise from the centre of the back. But perhaps the prettiest thing of all is to see it clean its ears. It puts its head on one side, pulls down its ear, and passes its two paws over it again and again most strikingly, like a lady dressing her hair. It can stand quite perpendicular, without support, upon its hind toes, and even advance some steps in that position, balancing itself by holding out its fore limbs horizontally. Its leaps are remarkable for their height, grace, and agility. It habitually overleaps its object, and comes down upon it with a curved descent, as beautifully as an antelope, thus contrasting with the cat, which scarce jumps up to the necessary height, while the hare overleaps it. I question whether it ever *runs* with its hind legs. I have had no proper opportunity of determining this point, and may be mistaken, but its ordinary habit is to walk and run with its fore legs, and only to hop with its hind.

In its disposition it is pacific, trustful, and affectionate in a most touching degree when its heart has been gained, and indeed even when it has not. My hare will always lick my hand in response to a caress, and by the same habit silently appeal to me for protection in any apprehended danger, as the presence of a stranger, or of some person whom it distrusts or dislikes. It never attempts to bite; but it is not without its means of offence and defence. One evening this hare came bolt into the dining-room, where the cat was. The cat was as startled as the hare, and roughed her tail. She had never seen a hare; the hare had never seen a cat, and prudently retired. A few days later the hare again visited the same room, and now neither was afraid of the other, as at the first interview, so the cat wanted to smell the hare; this was resented by the hare jumping over the cat and delivering a double blow with its hind feet, hitting the cat so hard that she is now afraid of the hare.

During the rutting season contests occur between the bucks. I once saw two hares manœuvring, when one jumped over the other, so striking it with its hind feet as to disable it. The striking hare instantly turned round, sat up, and drummed on its antagonist's body with its fore feet. During the battle there was no sound but that of the blows. My curiosity induced me to intervene. I picked up the vanquished hare;—it was dead.

Now comes the touching sequel.

The foregoing account was given to the Biological Section on March 21st, 1895:—On May 27th, a very hot day, my hare chose to sit from 10 a.m. to 6 p.m. in the full sun, outside my bedroom window. It

could go or come as it would. It was jubilant and gay on the previous day; but it did not come at tea time on the 27th and ask, as was its wont, for its bit of thin bread and butter, nor did it appear later in the evening, as usual, to play about the room. I could not find it anywhere, nor did it come when called. I thought it had its own reason. I went to bed at 12, leaving all doors open. At half past, in my first sleep, I was conscious of its presence in my bedroom, and dreamily aware that it made an unsuccessful attempt to jump upon the bed, dreamily satisfied that Bonnie Bonee was there. Presently it made another unsuccessful leap, then I awoke and took it on the bed by its ears. I found it was ill, placed it on my arm and stroked it. It licked my hand again and again as if to say it was happy, more happy than usual, —grateful and loving;—but presently, in about half an hour, it stretched itself out and died upon my arm. Sunstroke? Here is its epitaph, graven upon a brass tablet above its grave :—

> Hîc in tumulo dormiens Lepus Europæns jacet qui in domo angelus erat. Emigravit—Defleo.

I do not defend the Latin—what is that between my hare and me?

On October 1st, 1895, I obtained another hare, but it is a different hare, and as yet, December 15th, we have not become intimate, but are acquainted only. Though many of its habits are singularly identical with those of its predecessor, it is in many ways quite distinct, and thus far has taught me little; I know not what it *may* teach,—it is only getting tame. It seems affectionate, for it licks my hand in the same most delicate way as the first one did, but it is No. 2, and of second quality. It is much more nervous, and not so absolutely silent. It will sometimes bite, but only very gently. It will not yet eat bread and butter, or biscuits, and rejects some other foods which the first was fond of. It is a hare, but a different one. I think of it and feel towards it as I imagine a man may feel towards a second wife—a good and true wife—but not the same wife. No true man has two true wives, unless the truth between them is the truly common place, when one is just as good as any other.

I may know but little of the hare—but this I know—*Angelus est.* If anyone, who knows only so much, can afterwards eat jugged hare, I would by sovereign ordinance ordain that ever after he should have nought to drink but magnums of Clarke's blood mixture.

I think, generally speaking, that that the hare may be considered voiceless; but its shriek when overtaken or wounded is such as to reach the heart of the most robust sportsman. I have known one to say on such occasion: "Oh! kill the thing, I cannot bear to hear it." Ah, yes,—

> "So feels the fulness of our heart and eyes
> When all of innocence that can perish dies."

The one only and expiring cry of helpless, inoffensiveness,—"Oh, God! hast *thou* forgotten me?"—Brutish, heartless, selfish man! Indifferent God?

Report of the Committee for 1894-95.

THE Committee have the pleasure of presenting to the members of the Society their 28th Annual Report.

The number of members at the close of last session was :—

Number of members 1st October, 1894		452
Elected during 1894-95		46
		498
Deaths	3	
Resignations and removals	37	
		40
Number of members 1st October, 1895 ...		458

They are thus distributed :—

Honorary members	8
Life members	19
Corresponding members	6
Annual subscribers	425
	458

The Committee deeply regret the loss by death during the past year of Mr. J. W. Lukis, a past president and life member of the Society, of whom, at your Committee's request, Dr. C. T. Vachell has undertaken to write an obituary notice for publication in the Transactions. The other members who have been lost by death to the Society are Mr. E. H. Watts and Mr. E. H. Newill, the former of whom was an appreciated contributor to your proceedings.

The balance sheet shows a balance of £149 12s., carried forward into the new year.

The following is a list of papers read before the Society :—

MEMBERS' NIGHTS.

1894.

Oct. 26th.—Annual Meeting. Inaugural Address by the President—Mr. R. W. Atkinson, B.Sc., F.I.C.

Nov. 22nd.—Professor J. B. Haycraft, M.D., D.Sc., F.R.S.E.—"Animal movement."

1895.

Jan. 24th.—Professor Evan W. Small, M.A., B.Sc., F.G.S.—"Wind and Weather."

„ 31st.—Mr. C. Russell James—"The Japs."

Feb. 14th.—Rev. Geo. St. Clair, F.G.S.—"A Tour in Palestine."

Mar. 14th.—Mr. C. T. Whitmell, M.A., B.Sc., F.G.S.—"Recent progress in Planetary Astronomy" (1st paper).

The following public lectures have been delivered :—

1894.

Nov. 8th.—Rev. Canon Bonney, D.Sc., L.L.D., F.R.S., F.S.A., F.G.S.—"The Building of Western Europe."

„ 29th.—Mr. A. P. Laurie, M.A., B.Sc., F.C.S., F.R.S.E.—"Dust."

Dec. 13th.—Mr. E. A. Minchin, M.A.—"Sponges and their Life History."

„ 21st.—Sir W. M. Conway, M.A., F.S.A., F.R.G.S.—"Climbing in the Himalayas."

1895.

Jan. 10th.—Mr. Whitworth Wallis, F.S.A. — "In Search of Pharaoh."

Mar. 7th.—Professor Francis Gotch, M.A., F.R.S.—"Phrenology—Old and New."

„ 28th.—Professor V. B. Lewis, F.I.C., F.C.S.—"Flame and its Luminosity."

On the 14th March Mr. Edwin Seward presented his report as the Society's delegate at the meeting of the Corresponding Society's Committee of the British Association at the Oxford meeting 1894. It is much regretted that in consequence of an important local function occurring at the same date as this year's meeting of the Association at Ipswich, the President who was appointed delegate to the Committee of Corresponding Society's was unable to be present.

The thanks of the Committee are due to the members who have read papers, and also to those ladies and gentlemen who have entertained the lecturers.

During the past session the lectures and meetings have been held in the Queen Street Hall with the exception of the first one, which was held (by kind permission of His Worship the Mayor, Alderman P. W. Carey) in the Assembly Room, Town Hall, and the third in Professor J. B. Haycraft's Lecture Theatre, University College, Cardiff, on the occasion of his lecture on "Animal Movement."

The first Field Meeting was held on the 23rd day of May, when a visit was paid to the Cyfartha Steel Works, by kind permission of the Messrs. Crawshays.

The Annual Field Meeting (Ladies' Day) was held at Abergavenny and Partrishow and the Usk Valley on the 26th June, about seventy ladies and gentlemen being present. The members proceeded from Cardiff to Abergavenny, and thence to the Parish Church, where the party was met by the Rev. Canon Capel, under whose kind guidance the Church was inspected ; afterwards, to the Castle grounds, where the Castle ruins were inspected. Luncheon was partaken of at the Angel Hotel.

The Annual General Meeting was held shortly after, at which the Rev. Canon Thompson, D.D., was elected president for the present session. During the afternoon the members drove to Lantilio Pertholey, where the Parish Church was inspected, the Rev. A. F. Hogan (vicar) conducting the party through the sacred edifice and giving a short account thereof. The best thanks of the Society are due to him for his kindness on this occasion. The members thence proceeded to Partrishow Church, and after inspecting the same by the permission of the Rev. T. Jones (rector of Lanbedr with Partrishow), returned to Abergavenny, via Llangenny. Tea was partaken of at the Angel Hotel, and the return journey to Cardiff made by the 8.50 train.

The third Field Meeting was held on the 6th day of September, when a visit was paid to Fonmon Castle (by kind permission of O. H. Jones, Esq.). The principal features of the Castle were viewed, and the pictures and antiquities were described by Mr. Edwin Seward. The members on this occasion were entertained at tea by the President at the Barry Hotel.

The excavations on the Ely Racecourse have been closed in during the year, and a full account of the discovery, with a balance sheet, has been published in the Transactions in Vol. XXVI , part 2.

During the year your Committee have, under the new rules, elected the following gentlemen corresponding members of the Society :—

1.—W. O'Connor, Church Villa, Pentre.
2.—Rev. A. F. Hogan, Llantilio Pertholey, Abergavenny.
3.—Evan John, J.P., Llantrisant.
4.—Digby Nichol, The Ham, Llantwit Major.
5.—Iltydd Nichol, The Ham, Llantwit Major.
6.—G. A. Birkenhead, Downs View, Penarth.

Your Committee has appointed a Sub-committee, consisting of the President, Dr. C. T. Vachell, Messrs. O. H. Jones, T. W. Proger,

Digby Nicholl, J. J. Neale, R. Drane, T. H. Thomas, and the Hon. Sec., to deal with the question of the Protection of Wild Bird's Eggs within the Society's district, under the Wild Birds' Protection Act, 1894. Before this was done, however, the Glamorganshire County Council had obtained an order under the Act protecting the eggs of the Kingfisher and Goldfinch. The Sub-committee, therefore, took active steps to cause the existence of the order to be made known to such persons as were in the best position to prevent offences against the order, and offered a reward for the detection of offenders.

To the officers of the Society the Committee are indebted for the services rendered by them during the year in their respective offices, and more particularly to our able Honorary Secretary to whose assiduous efforts the Society owes so much.

Since the last report of the Committee, two parts of the Transactions have been issued, viz.: Part 2 of Vol. XXVI., and Part 1 of Vol. XXVII., the former containing some beautiful illustrations to the paper by Dr. C. T. Vachell on "Local Narcissus," the cost of which has mainly been defrayed by him.

CARDIFF NATURALISTS' SOCIETY.

Balance Sheet for the Year ending September 30th, 1895.

Liabilities.	£	s.	d.
To Sundry Creditors	70	13	4
,, Conversazione Reserve Fund	21	1	0
,, Exploration ,, ,, ...	4	9	1
,, Balance, being excess of Assets over Liabilities ...	149	12	0
	£245	15	5

Assets.			£	s	d.
By Value of Furniture			10	3	0
,, ,, Library			7	5	1
,, Investments, viz.:					
£112—Barry 4% Preference Stock	£127	0 7			
Cardiff Building Society	55	3 5			
			182	4	0
,, Cash in Lloyds Bank			13	14	7
,, ,, in Treasurer's hands			14	15	9
,, Subscriptions in Arrear			5	15	6
,, Value of Reports unsold			10	0	0
,, ,, Flora ,, ...			1	17	6
			£245	15	5

Dr. **Revenue Account for the Year ending September 30th, 1895.** *Cr.*

	£	s.	d.
To Reports and Transactions	61	17	3
,, Field Meetings	4	11	1
,, Lectures	113	17	8
,, Monthly Meetings	24	5	9
,, Stationery, Printing, and Advertising	26	10	9
,, General Expenses, including Collector's Commission	32	7	4
,, Incidental Expenses	2	14	8
,, Conversazione Reserve Fund	10	8	0
,, Exploration ,, ,, ...	4	9	1
,, Written off for Depreciation of Library ...	1	0	0
,, ,, ,, ,, Furniture ...	1	0	0
,, ,, ,, ,, Flora ...	2	0	0
,, Balance to be carried to next year's account ...	149	12	0
	£434	13	7

	£	s.	d.
By Balance from last year's account	166	10	10
,, Subscriptions	252	10	0
,, Life Members Subscription	5	5	0
,, Ely Exploration Fund	4	9	1
,, Interest on Investments	5	18	8
	£434	13	7

CARDIFF, 14th October, 1895.

W. RÖNNFELDT,

Hon Treasurer.

WENTWORTH H. PRICE,

Chartered Accountant, *Auditor*,

CARDIFF, 18th October, 1895.

Report of the Hon. Librarian for 1894-95.

OF fifty-nine Societies on our exchange list, Transactions have been received from thirty-nine during the current year, a complete list of which is herewith given. Special attention may be drawn to the very valuable series of publications received from the University of Upsala, Sweden, and to the complete works of Dr. Geo. Engelmann, presented by the Missouri Botanical Garden.

All the publications received by this Society are deposited in the Central Public Library, and may be borrowed by any member of the Society on application to Mr. Ballinger or to one of the assistants. The thanks of the Society are due to Mr. Ballinger for the attention he bestows upon the Society's library.

R. W. Atkinson,

Hon. Librarian.

List of Societies Exchaning and of Transactions received from October 1st, 1894, to September 30th, 1895.

Astronomical Society of Wales ; Journal, vol. I., parts 1-3, part 5, and part 9.
Bath Natural History Society ; Proceedings, vol. VIII., part 2.
Belfast Naturalists' Field Club.
Belfast Natural History Society ; Report and Transactions, 1893-94.
Berwickshire Naturalists' Club ; History, 1892-93.
Brighton and Sussex Natural History Society.

Bristol Naturalists' Field Club ; Proceedings, vol. VII., part 3.
British Association ; Annual Report, 1894. Oxford.
Chester Society of Natural Science ; 22nd Annual Report, 1892-93.
Christiania, University Library of
Cornwall, Royal Polytechnic Society ; Annual Report, No. 62.
Dublin Royal Society.
Dumfriesshire and Galloway Natural History Society ; Transactions, No. 10, 1893-94.
Dulwich College Science Society ; Annual Report, 1893-94.
Ealing Microscopical Society.
East Kent Natural History Society.
Essex Field Club ; Essex Naturalist.
Glasgow Geological Society.
Glasgow Natural History Society ; Proceedings and Transactions, vol. IV., part 1.
Glasgow Philosophical Society ; Proceedings, vol. XXV.
Hampshire Field Club.
Hertfordshire Natural History Society.
Holmesdale Natural History Society.
Isle of Man Natural History Society ; Yn Lidar Manninagh, No. 12.
Leicester Literary and Philosophical Society ; Transactions, vol. III., parts 7 10.
Leicester Literary and Philosophical Society ; Transactions, vol. IV., part 1.
Leopoldina ; Heft 30. Also two separate publications.
Lewisham and Blackheath Scientific Association.
Liverpool Geological Association ; Journal, vol. XIV.
Manchester Field Naturalists' Society ; Report and Proceedings, 1894.
Manchester Geographical Society ; Journal, vol. IX., Nos. 9-12 ; vol. X., Nos. 1-9.
Manchester Geological Society ; Transactions, vol. XXIII., parts 1-9.
Manchester Microscopical Society ; Annual Report and Transactions, 1893 and 1894.
Marlborough College Natural History Society ; Report, No. 43, 1894.
Minnesota Academy of Natural Science ; Occasional Papers, vol. I., part 1.
Missouri Botanical Garden ; 6th Annual Report, 1895.
Missouri Botanical Garden ; Collected Works of Dr. G. Engelmann.
Monmouthshire and Caerleon Antiquarian Association.
New South Wales Geological Survey ; Records, vol. IV., parts 2, 3.
Norfolk and Norwich Natural History Society ; Transactions, vol. V., parts 3-5.
Northamptonshire Natural History Society ; Journal, Nos. 57-60.
Northumberland and Durham Natural History Society ; Transactions, vol. XI., part 2.
Nottingham Naturalists' Society ; Report and Transactions, 1894.
Nova Scotia Institute of Science ; Proceedings and Transactions, vol. I., part 3.
Philadelphia Academy of Natural Science ; Proceedings, 1894, parts 2, 3, 1894, part 1.
Rassegna della Scienze Geologiche in Italia.
Rochdale Literary and Scientific Society ; 16th Annual Report, 1894.
Royal Microscopical Society ; Transactions, 1894, Nos. 5, 6, 1895, Nos. 1-3.
Smithsonian Institution ; Reports, 1892 and 1893.
South Eastern Naturalist ; Transactions, vol. I., part 4.
Southport Society of Natural Science ; 2nd Annual Report, 1891-93.
Staffordshire (North) Naturalists' Field Club.
Stockport Society of Naturalists.
Toscaña, Societa della ; Atti, vol. IX., July and November, 1894, January and March, 1895.
United States Department of Agriculture.
United States Geological Survey ; Annual Reports, 12, 13, and 14 ; Mineral Resources, 1892, 1893 ; Monographs, Nos. 19-24 ; Bulletins, Nos. 97-122.
United States National Museum ; Reports, 1892, 1893.
Upsala, University of ; Bulletins of Geological Department, vol. I., parts 1-3.
Upsala, University of ; 74 publications.
Wicsonsin Academy of Sciences, Arts, and Letters.
Woolhope Club.
Yorkshire Naturalists' Union.

CARDIFF NATURALISTS' SOCIETY

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1894—EDWIN SEWARD, F.R.I.B.A.

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T. W. Edgworth David, Sydney, N.S.W.

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Turberville, Colonel, Ewenny Priory, Bridgend.

Annual Members, 1st October, 1895.

Alexander, D. T., Dinas Powis.
Allen, S. W., Wordsworth Street.
Ambrose, D. R., Llanmaes, St. Fagans.
Andrews, Councillor T., Newport Road. Cardiff.
Andrews, Mrs. T., Newport Rd., Cardiff.

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Bassett, A. B., 4, Church Street.
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Bland, G., Angel Hotel.
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Burt, M., 51, Newport Road.
Campbell, W. (M.D.), 95, Newport Rd.
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Carter, J. Coates, 98, St. Mary Street.
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Clay, C. L., 19, Charles Street.
Clothier, E. H., 6, Hickman Rd., Penarth
Coleman, Alfred, 65, St. Mary Street.
Coleman, E. J., 8, High Street.
Coleman, G. T., The Infirmary.
Coleman, Sidney, Beach Field, Penarth.
Collin, Miss M., 4, Park Place.
Collins, E. Tenison (M.R.C.S.), 12 Windsor Place.
Common, Mrs., Park Place.
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Cook, Walter, 98, St. Mary Street.
Cooper, S., The Walk.
Copland, Miss, 45, Conway Road.
Cope, Matthew, St. Mellons.
Corbett, E. WM., Castle Street.
Corbett, J. S., Castle Street.
Cornish, Havelock, Windsor Road, Penarth
Cory, Councillor J. Herbert, Ty'n y Park, Whitchurch.
Cory, John, Porthkerry, Barry.
Cory, John, c/o Cory & Sons, Mount Stuart Square.
Cory, Richard, Oscar House, Newport Road.
Cousins, Harry, Glyn Tower, Bridgeman Road, Penarth.
Culley, R. P., Lydford House, Cathedral Road.
Culley, Mrs. R. P. ,, ,,
Darling, W. J., Lloyd's Registry Office, Barry Dock.
Davey, H. Wood, 53, Newport Road.
David, Mrs. Edward, The Hendre, Llandaff.
David, J. T., Energlyn, Caerphilly.
Davies, Mrs. T., 15, Westbourne Cres.
Davies, John, The Walk.
Davies, John, Hafan Dawel, Plasturton Place.
Davis, Miss H., 8, Wordsworth Street.
Davis, Wm., 48, Richmond Road.
Dawe, A. Hawke, University College.
Dawson, Miss, 43, Splott Road.
Dawson, Gerald, 4, Bradenham Place, Penarth.
Deacon, Henry, 34, Queen's Square, Bristol.
Downes, C. H., Church Street.
Downing, G. C., Pendene, Llanishen.
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Duncan, J., Llandough.
Duncan, R., The Buttrils, Barry.
Dunn, Tregerthen, 108, Newport Road.
Earl, Edward, Windsor Place.
Earl, Henry, 9, Richmond Road.
Edwards, Edward, 37, The Walk.
Edwards, J. T., 3, Richmond Crescent.
Edwards, W. T. (M.D.), Queen Street.
England, E., Marine Parade, Penarth.
England, R., 33, Park Place.
Ensor, H. Collin (M.R.C.S.), 23, Windsor Place.
Evans, C. H., 33, Newport Road.
Evans, D. Tyssil, University College.
Evans, Evan, 36, Park Place.
Evans, C. Telford, 14, Queen Street.
Evans, Franklen G. (F.R.M.S.), Llwynarthen, Castleton, Mon.
Evans, J. H. Westyr, Cefn Bryn, Penarth.
Evans, W. M. Hier, 80, Richmond Road.
Evens, Thomas, 29, Park Place.
Fairlamb, W., Rhymney Railway.
Farrance, Thomas, 2, Ninian Road.
Fisher, Miss, Church Terrace, Penarth.
Fletcher, Ed., St. Andrew's Crescent.
Foster, W., 9, Dumfries Place.

Fowler, C. B., Douglas House, Cathedral Road
Fownes, Mrs., 20, Claude Road.
Franklen, T. Mansel, County Offices, Westgate Street.
Fulton, Alderman A., Park Place.
Galloway, Prof. W., 19, Newport Road.
Gaunt, L. G., 49, Mount Stuart Square.
Geen, Wm., Penylan.
George, J. E., 2, St. Andrew's Place.
Gibbs, W. B., 4, Marine Parade, Penarth.
Gooch, C. F., Cathedral Road.
Gough, J. H., 8, Berthwin Street, Cathedral Road.
Gough, Mrs. J. H. ,, ,,
Greener, M. H. (M.B.), 1, Clare Street.
Greenslade, Frank, Metropolitan Bank, Cadoxton.
Greig, W., Severn Rd. Board Schools, Canton.
Grew, C., Alfred Street, Roath.
Griffiths, Rev. D. H., St. John's Vicarage.
Griffiths, P. Rhys (M.B.), 71, Newport Road.
Griffiths, Wm., 42, The Parade.
Grover, Miss, Queen Street.
Grylls, W., Llanishen.
Gunn, John (J.P.), Llandaff.
Hacquoil, F. P., Cathedral Road.
Hallett, J. H., Maindy Lodge, Maindy.
Halliday, G. E., Llandaff.
Halliday, Mrs. G. E., Llandaff.
Handcock, E. W., jun., 187, Newport Rd.
Handcock, Edward, 168, Newport Road.
Harper, Alfred, 21, Plymouth Rd., Penarth
Harris, Miss M. A., 24, De Burgh Street.
Harrison, F. B., Waterworks Office, Town Hall.
Harrower, Miss N., 34, Hamilton Street.
Harwood, P. B., Canal Office, Sea Lock.
Haycraft, Professor J. B., University College.
Heathcote, Major, Cathedral Road.
Hedley, Right Rev. Bishop, Llanishen.
Heigham, Mrs., Llandaff.
Heitzman, C. A., 100, St. Mary Street.
Heywood, C. A., Holme Tower, Penarth.
Heywood, H. (J.P.), Witla Court, St. Mellons.
Hibbert, F. A., Fernleigh, Park Place.
Hicks, W. T., 25, The Parade.
Hobart, Austin, 182, Newport Road.
Holdaway, E. D., Stonebury House, 171, Newport Road.
Hollyer, J. S., 193, Newport Road.
Hooper, Miss, 43, Charles Street.
Hooper, Thomas, The Cottage, Llanishen.
Hooper, T. J., 53, Fitzhammon Embank't.
Hopkins, Miss H. H., The Parade.
Hopkins, Geo., The Hayes.
Howard, Chas. Fred., 59, Despenser Street.
Howard, F. T., University College.
Howe, John, Leicester House, Llandaff.
Howell, J., The Walk.
Hughes, Professor A. W., University College.
Hughes, Thos., 31, Loudoun Square.
Hunt, D. de Vere, 13, Westbourne Crescent.
Hurley, E. C., Mount Stuart Square.
Hurman, James, Llwyncrwn, Llanishen.
Huxtable, W. D., 8, Richmond Terrace.
Insole, J. H., Landaff.
Isaac, John, Penarth.
Jack, Gavin Heynes, Pontypridd.
Jackson, C. J., Penylan.
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James, Chas. Russell, 8, Courtland Terrace, Merthyr.
James, Ivor, University College.
James, W. P., The Lindens, Canton.
Jefferies, H., Plâs Newydd, Penarth.
Jenkins, John, 203, Newport Road.
Jenkins, W. J., Park Place.
Jenks, Edward, 28, Park Place.
Jones, H. Bithwell, 2, The Parade.
Jones, J. A., 10, Partridge Road.
Jones, Miss M., 17, Prince Leopold St.
Jones, David, Oak Villa, Richmond Road
Jones, Rev. Hartwell, Nutfield Rectory, Redhill.
Jones, Principal J. V., University College.
Jones, J. A., 206, Newport Road.
Jones, John, T.V.R. Office.
Jones, O. H., Fonmon Castle.
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Jones, Capt. W., 42, Cowbridge Road.
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Jotham, T. W., Penylan Road,
Kempson, F. R., Llandaff.
Kerslake, J. S., Chepstow Villa, Chepstow Road, Newport.
Kinloch, Robt., 3, East Terrace.
Kirkhouse, H., Bryn Bedw, Tylorstown,
Kite, Geo., 16, Clare Street.
Knight, Rev. Chas., Tythegston Court, Bridgend.
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Williams, Miss H., 11, Wellfield Road.
Williams, Jesse, 34, Windsor Place.
Williams, J. A. B., 11, Charles Street
Williams, T. J., 34, Newport Road.
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Woods, Col. Thos., Llandaff Place.
Wotton, T. W., 42, Sothley Rd., Highbury, London.
Yorath, W. L., 158, Richmond Road.

Corresponding Members.

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Hogan, Rev. A. F., Llantilio Pertholey, Abergavenny.
John, Evan, J.P., Llantrissant.
Nicholl, Digby, The Ham, Cowbridge.
Nicholl, Illtyd, The Ham, Cowbridge.
O'Connor, W., Church Villa, Pentre, R.S.O.

Rules.

1.—That this Society shall be called the "CARDIFF NATURALISTS' SOCIETY," and shall consist of Ordinary, Honorary, and Corresponding Members.

2.—That Ladies shall be eligible as Members.

3.—That the objects of the Society shall be the practical study of Natural History, Geology, the Physical Sciences, Archæology, Art, Literature, and other kindred subjects; and to assist in the development of the Cardiff Museum.

4.—That the Society shall be managed by a Committee, consisting of—

(1). A President (who shall be Vice-President for three years on his retirement from Office).

(2). The Vice-Presidents so created.

(3). Such of the past Presidents as shall in reply to an annual circular from the Hon. Sec. consent to serve.

(4). An Hon. Treasurer.

(5). Hon. Curators.

(6). An Hon. Secretary.

(7). An Hon. Librarian.

(8). The Hon. Secs. of each section of the Society.

(9). Twelve other Members of the Society,

and that, in Committee Meetings, three shall form a quorum.

5.—The Committee shall have power to appoint Trustees of the Society.

6.—That the Annual Meeting shall be held in the month of October, at which the Committee and Officers, excepting only the President, shall be elected for the following year by ballot, or by show of hands, as per Rule 8. The President shall be elected at the Annual Field Meeting (held at Midsummer), but shall not take office until the Annual Meeting of the Society in October following.

7.—That the General Meeting shall be held on the Fourth Thursday in every month, at Eight o'clock p.m.; Committee Meetings at the same hour at the call of the President, and that a discretionary power shall be vested in the Committee to alter the times of all Meetings, when necessary.

8.—That all candidates for Ordinary Membership shall be proposed and seconded by existing Members, either verbally or in writing, at any Meeting of the Society, and shall be eligible to be Ballotted for at the next Meeting, provided there be Five Members present. That One black ball in Five shall exclude a candidate. That a show of hands shall be taken if the Meeting prefer it, but that any Member may demand a Ballot. Honorary Members shall be nominated by the Committee, and elected or otherwise at the next Ordinary Monthly Meeting.

9.—That all Members whose Subscriptions are one year in arrear shall forfeit their privileges of Membership. Those who are two years in arrear shall have their names erased. But no forfeiture of privileges or Membership shall exonerate the Member from the payment of all sums previously due to the Society.

10.—That any Member who has withdrawn from the Society after proper notice, as per Rule 11, shall be eligible for re-election at any future time; but Members who have allowed their Membership to lapse by default shall be disqualified for election as new Members, and can only regain their lost status by payment of all arrears.

11.—One Month's Notice of Withdrawal from Membership shall be required, such notice to be given in writing to the Hon. Secretary on or before August 31st.

12.—That the Committee shall have power to exclude any Member for misconduct; but that such Member shall have a right of appeal to the next Ordinary Meeting of the Society, after giving 14 days' notice to the Hon. Secretary.

13.—That the Annual Subscription for Ordinary Members shall be Ten Shillings and Sixpence (payable in advance to the Hon. Secretary on the First of October in each year), entitling each Member to a Copy of the Transactions and to Free Admission to all Public Lectures and Meetings of the Society. Members may commute the Annual Subscription into one payment of Five Guineas.

14.—That specimens collected by the Members of the Society and deposited in the CARDIFF MUSEUM shall become the property of the CORPORATION OF CARDIFF, under the provisions of the Museum and Gymnasium Act, 1881; but specimens only lent shall be returned to their Owners upon application.

15.—One Month's Notice shall be given of any proposed alteration in the Rules.

16.—Every Member on election shall have a Copy of the Rules forwarded to him by Post, together with the Notice of his Election; and the payment of his Subscription shall be deemed an acknowledgment of Membership.

17. —Corresponding Members shall be persons who may be able to contribute to the Work of the Society without wishing to become Ordinary Members. They shall be nominated by Two Members of the Society and elected by the Committee, and shall be subject to annual re-election. They shall be entitled to all privileges of Ordinary Members except notice of and free admission to Public Lectures and Members' Nights.

18.—Any person being a bona fide student may be elected an Associate of the Society, the election to be conducted in the manner prescribed by Corresponding Members. Such Associates shall pay an Annual Subscription of Two Shillings and Sixpence. They shall be entitled to attend all Meetings of the Society, but shall not be entitled to copies of the Transactions except on payment of one-third of the published price. Associates shall cease at the age of 21.

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John Walter Lukis

(Past President).

Died November, 1894.

It has become customary to honour the memory of our Past Presidents by inserting at their death, in these Transactions, a short memoir of their work in connection with the Society.

John W. Lukis was born in 1816, being the second son of Frederick Corbin Lukis, The Grange, Guernsey. He was educated at Elizabeth College, Guernsey, and was by profession a Mining Engineer. His father had made a special study of chambered tumuli, and was the first to examine those of the Channel Islands. In this work he was assisted by his son John, who was therefore brought up in an atmosphere of Archæology. Later, John W. Lukis made plans and drawings of these remains, and helped to catalogue the finds, which have recently been handed over to the authorities of St. Peter Port, where a special building is being provided for their reception.

Mr. Lukis settled in Cardiff in 1872, and forthwith became a member of our Society, and in June read a paper on Chambered Tumuli. His reputation as an Archæologist was at once established.

In 1873 he was elected a Vice-President, and read a paper on "The Flint Implements of the Drift Period." In the following year he read papers on "Tumuli, or Earth Mounds," and "The Tumulus at St. Nicholas."

In 1875 he was elected President, and read papers on (1) "Some of the Primitive Customs of Man," (2) "The Lake Dwellings of Llangorse Lake," (3) "Some small Leaden Effigies, and Remark on an Ancient Tablet or Pax said to have been found at Bath," and (4) "The Roman Quern."

In 1876 he read papers upon (1) "The pleasures and advantages to be derived from the study of Natural History," and (2) "The Habits of the Mouse."

He was again elected President in 1877, but on 24th April resigned in consequence of a change in his plans which necessitated his leaving

Cardiff. He now removed to St. Fiacre, a residence near Morlaix in Brittany, where he continued to live until the death of his wife in 1893. He then gave up his home and went to live with his brother, Capt. Frank Lukis, at St. Peter Port, Guernsey. He was at this time in very bad health, and died in the following year, 1894.

Mr. Lukis earned his rapid promotion to the President's chair not from many years of services rendered to the Society, but by the remarkable enthusiasm with which, during the few years of his residence in Cardiff, he exerted himself to promote its welfare and best interests.

Unlike the majority of our members, whose leisure is of the briefest, Mr. Lukis was favoured by having ample time at his disposal, and nothing then pleased him more than to meet the friends he made from amongst our members, and discuss with them matters pertaining to Archæology and Natural History.

He possessed good collections of minerals, and of objects found in the chambered tumuli of the Channel Islands, and these he was never weary of showing and explaining to any whom he found interested about them.

His genial manner, together with his keen interest in all matters relating to Archæology and Natural History, soon won for him a number of friends in the Society, and his was a familiar and welcome presence at all our meetings so long as he continued to live amongst us. His departure for Brittany caused a void which was long felt; he himself felt the leaving very keenly, and one of his last acts before starting was to ensure a lasting interest in our proceedings by becoming a life member of the Society.

Presidential Address.

By REV. CANON THOMPSON, D.D.

The Educational Value of Holiday Travel.

FIRST, a word or two as to the nature and character of our Society. I regard it as a body of people of similar tastes and aims joined together in mutual fellowship—*first*, for purposes of self culture, and *next*, for distributing, as widely as possible, the pleasures and benefits which wait on the cultivation of intellect and taste.

Its aim I consider to be the pursuit and enjoyment of knowledge. As a Naturalists' Society our first and chief work, undeniably, lies in the field of natural science, but we believe in the unity and universality of knowledge; and by many indications, among them being the election of myself to the prized position of its President, we have widened its scope to the inclusion of literature and art. We want to quicken the spirit of intellectual and scientific inquiry—we want to kindle an enthusiasm for all that ennobles life and lifts a man out of and above the sordid common-places of his daily anxieties and daily round—we want to shew him that there are nobler, worthier things than self-indulgence and passing pleasures. We want to bring him into contact with the great thoughts both of the present and the past—with the great minds who sit astride the ages—with the men whose lives are an inspiration, and whose examples are worth emulating—we want to bring about a worthy use of leisure, and a reverence for time—we want, in a word, by our poor methods, poor in comparison of the highest, yet with an excellence all their own, to shew to all that their faculties of intellect, of memory, of imagination, are gifts divine, and that they may, if they will, make their life worth the living.

In the spirit of these words, I would say just a word or two, mainly intended for the members of our various sections. Our Society is large,

and generous in its terms of association, but we must not forget that its animating motive is work. The majority of our members are, and must be, comparatively speaking, non-workers. We are content that it should be so, provided that the original aim and intention of the Society is not lost sight of. We have no wish to alter its popular character, but we are very jealous that the real purpose for which we exist as a Society should be steadily kept in view, and adhered to. We, then, who belong to the sections must be workers. We are quite willing, within limits, to play, but we must work, first and chiefly. I am only free to speak thus of the Archæological Section, which has yet its laurels to win. In this section, we have a Secretary of unique capability, and I feel sure I have him with me when I say that hard walking—if need be, high thinking, and frugal fare will be the fittest characteristics of our sectional excursions.

In considering what should be the subject of my address to-night, I wisely concluded that it would be a most disastrous thing for the President of a learned Society to flounder in waters beyond his depth, and resolved, therefore, that I would, at least, talk about things which, in some degree, I fairly understand. My theme is this. Nowadays, most people have spaces of leisure, they also have holidays, and many among us press into those delightful weeks, our knowledge of men and things, and drop here and there into places famous for natural beauty, scientific interest, or inspiring association. Holidays thus spent are a "Continuation School," they are capable of furnishing the best education we can receive. This is the idea I wish to illustrate. For that purpose, my first intention was to take four chief intellectual and artistic centres of modern time—shew you on the sheet something of their objects of interest—some of their great men—and do my best to help you to a livelier interest in things worth knowing, and stimulate you with a desire to know more. My choice was Edinburgh, Antwerp, Venice, and Florence. But the scope and range was too wide, and I have thought it better to limit our attention to Venice and Florence only. This, however, I may remark, in passing, that there would be a fitness in the juxta-position of the four cities. Edinburgh and Antwerp both played in the north a similar part to their southern sisters, to whom they were singularly akin in intellectual and artistic activity. Antwerp is known in history as the Venice of the north, was long its competitor in commerce, and at last its successful rival.

The remainder of the address, which was delivered without manuscript, and was wholly colloquial in form, was taken up with a description of Venice and Florence—their history, their art, their glory, and their shame. If, of Venice, her latest and most eloquent chronicler could write:—"A city which was to be set like a golden "clasp on the girdle of the earth, to write her history on the white scroll "of the sea surges, to word it in their thunder, and to gather and give "forth in world-wide pulsations, the glory of the west, and of the east, "from the burning heart of her fortitude and splendour," of Florence it may be said with equal truth that, since the days of Athens, no community

has won for itself such imperishable splendour in every field of highest enterprise, or contributed so richly to the intellectual growth and progress of mankind.

The history, architecture, art, and social characteristics of both cities were rapidly passed under review, and by the aid of some excellent lantern slides, the lecturer was able to vindicate, by a comparison between mediæval and modern examples, Ruskin's dictum, that a building should do three things: "(1) Act well; (2) Speak well; (3) Look well." In dealing with Florence, he dwelt on the amazing fertility of soil which, in a civic community with less than a sixth of the population of Cardiff, and within one period of contemporary time, could produce a Dante, a Machiavelli, a Savonarola, a Donatello, a Michael Angelo, and said that in the "makers of Florence" we see, perhaps, the most illustrious group of contemporary men of genius of whom history gives us record. Meantime, Venice, Florence, and many another famous source of inspiration, was within easy reach of Cardiff, eminently suitable as an object of holiday travel, and capable to a sympathetic mind and eye, of fulfilling the joint purpose for which this Society exists, viz., "the promotion of self-culture, and the distribution "to others of the pleasures and benefits which wait on the cultivation of "intellect and taste."

The Moon as a View-Point.

By C. T. WHITMELL, M.A.

Read (in part) 14th March, 1895.

ON 14th March and 14th November, 1895, I had the honour of reading before the Society Papers upon "Recent Progress in Planetary Astronomy." We are so accustomed to regard the Universe from a terrestrial point of view, that—after dealing with the Planets and their Satellites—I thought it might not be amiss to transport ourselves in imagination to each of them, and endeavour to survey the Solar System from veiw points less familiar than our Earth. This Article is an expansion of that portion of my first Paper in which a Lunar stand-point was taken.

The Lunar Landscape and Climate.

Except Meteorites and Shooting Stars no other celestial body approaches nearly so close to us as the Moon. Venus, which comes next, is still, even when nearest, more than a hundred times further away. Light, which requires about four years to travel from the nearest fixed Star, takes only one second and a quarter to travel from the Moon.

The remarkable features of the lunar surface are so well seen from the Earth, that it is not difficult to picture what they would be like were we able actually to visit them. The rills or clefts in the rocky crust, 100 to 500 yards deep, half a mile to two miles wide, and in certain cases hundreds of miles long, may in some respects possibly be paralleled by the great Cañons of the Colorado and other Rivers in the west of the United States, though the lunar ravines are more probably cracks than water-made valleys. The volcanic formations, though more numerous and generally larger than those of our Earth,

remind us in many ways of extinct terrestrial volcanoes. The bright rays or streaks also much resemble volcanic dykes on a large scale. Besides these, there are lofty mountain ranges, broad plains, and vast hollows, which seem to be the beds of vanished oceans. But for details of the surface-features of our Satellite, reference must be made to special treatises.

Could we reach the Moon, we should easily settle the much debated question as to reality of small changes in her features, or the presence of an atmosphere, so rare as to be imperceptible by us. I do not think that we should notice any decided colours in the rocks, though there would be minor variations. To us the Sea of Serenity presents a greenish shade, as do some other portions of the surface, while others appear gray or yellowish.

There is not the smallest reason for supposing that the unseen part of the Moon differs, in any essential characteristic, from the visible part, which, owing to librations, includes about three-fifths of the whole surface.

In sunshine the heat and glare would be very intense, but, out of the direct light, the cold and darkness would be alleviated only by reflection from illuminated rocks. The absence of the softening and mitigating action of an atmosphere would be very noticeable. There could be none of the lovely effects of aërial perspective, no magical mist to veil the mountains, no heaven domed with blue or flecked with fleecy cloud. Shadows would be sharp and black, and far-off lofty ranges would look quite near at hand.

"No more of those vapourous tints, which on the Earth increase the distances; no "more of those vague and charming lights which float over sunlit valleys; no more "of that celestial azure, which—paling from zenith to horizon—veils in transparent "blue the far-off mountains. A light, dry, homogeneous, dazzling, illuminates "harshly the rocky craters, while everything not directly exposed to the Sun "remains in night."—*M. Flammarion.*

The changes of temperature would be terrible, but the main reasons for these changes are not the varying distance from the Sun, or the deviation of the Moon's axis from perpendicularity to the Ecliptic, a deviation which is very small, though these would have some slight influence. The really predominating causes are the absence of the moderating action of an atmosphere, and the great length of the cloudless lunar day and night, each of which at the equator endures 14¾ of our days, or 354 hours.

On the Earth we have no near parallel to this condition. But, if we neglect refraction, places, about 18 miles within the Arctic Circle, have at the Summer Solstice about 14¾ days of unsetting Sun. The top of a mountain, 4,200 feet high, situated about 50 miles south of the Frigid Zone, would also have continuous sunlight for about 14¾ days at the Solstice, and—the air being rare—we come to the lunar condition a little nearer than at the sea-level. But these suggested cases are merely loose analogies, by no means strict parallels. In the mountain example we have the 14¾ days of unbroken sunlight

preceded, for nearly six months, by days lengthening up to 24 hours, and succeeded by days gradually shortening (in six months, less a week) to zero, followed by 14¾ sunless days, and so on.

But on the lunar equator there is a continuous day, followed by a continuous night, each 14¾ days long. The lunar axis being almost perpendicular to the ecliptic, there could be no lunar seasons in our sense of the term. For any place on the Moon, the Sun's mid-day height in Summer exceeds by only 3° his mid-day height in Winter. The lunar year comprises only about 12 complete lunar days or lunations, each of them about equal to 29½ of our twenty-four hour days, so that there are about 354 terrestrial days in a lunar year, the year of the Mohammedans.

Still it is true that lunarians, between the pole and the equator, would find, as their latitude increased, the lunar daylight lengthen in the lunar Summer, and shorten in the lunar Winter, but the changes would be very slow, and, unless the latitude is extreme, very slight. It is possible that there are polar peaks which never from their summits lose the Sun. A height of 2,000 feet, near the poles, would be sufficient to provide our Satellite with Mountains of Eternal Light.

The Sun is always almost vertically over the lunar equator, and on the horizon if seen from the poles. The extremes of temperature are thus greatest about the equator, each part of that region receiving continuous sunlight for 14¾ days, followed by a freezing night of the same length. But, in the absence of atmosphere, it is extremely likely that the radiation into space would be such as to prevent any great accumulation of heat. According to some estimates the temperature of the unlit part may fall 200° below zero. Such alternations of heat and cold must severely strain the surface rocks, and, if disintegration is ever observed, I should expect it to be seen near the lunar equator.

If Meteorites fall upon the Moon, they cannot before arrival be discerned as Shooting Stars, owing to the absence of the atmospheric friction requisite to raise them to incandescence. It is hardly necessary to point out that, in an airless world, sound would be absent, music non-existent, and that conversation could be carried on by signs only.

Lunar Gravity

Lunar gravity (it might almost be called lunar levity) is six times feebler than terrestrial. Weighed in a spring-balance, a ton of coal here scales at about 3 cwt. on the Moon. An Alpine Club man would easily take his weight up the highest mountains, and could leap down ordinary precipices with impunity. A stone, projected from a lunar volcano towards the Earth, would need an initial velocity of about only 8,000 feet per second in order to arrive at a point where the Earth's attraction exceeds the Moon's, and thus the stone would eventually reach the Earth.

The weakness of lunar gravity should be borne in mind in connection with the vast relative size of our Satellite's surface-features. On the

Moon, volcanic forces, equal to ours, would project material to much greater distances.

The Sun seen from the Moon.

From the Moon the Sun would appear of about the same size as to us, the slight variations being also practically the same, as the Moon is always our close companion. We will suppose our observer to be on the lunar equator.

The Sun, unannounced by any twilight or rosy dawn, ascends slowly in a dark eastern sky, lighting the higher mountain summits, while the valleys remain plunged in profound shadow. As he would take about an hour, instead of, as in England, only about five minutes, to rise, there will be noticeable, possibly for half an hour, a gradual increase of brightness. But all the gorgeous colour harmonies of our sunrises will be wanting. He attains the zenith in about 7½ days, and thence descends slowly to the west, setting after about 7½ days more, unattended by any glow of gold or crimson, and unfollowed by any twilight. His disappearance brings the long lunar night of nearly 15 days' duration. The shadows cast by the sunlight would shorten and lengthen very slowly, disappearing when the Sun is in the zenith. In the absence of atmosphere the Sun would be intensely bright and hot, and whiter than we see him, possibly even tinged with blue or violet. The crimson border with flaming prominences, and the pearly-shafted corona, will be visible without eclipse or spectroscope, if we artificially screen off the actual glare of the disc.

That puzzling problem, the origin of the Zodiacal Light, would soon be solved, so constantly and favourably would this lenticular appendage of the Sun be observable.

The Stars seen from the Moon.

Untwinkling Stars, far more numerous than we see them, and set in a sky of inky blackness, will shine much more brightly than with us, and be visible, not only at night, but also by day, and in a similar way will the Planets be conspicuous. To an observer on the Moon's equator, of which the axial velocity is only ten miles an hour, the Stars will be above the horizon, not for 14¾ days like the Sun, but for only 13⅔ days. To an observer at the Pole the Stars will complete a revolution in 27⅓ days. The lunar Pole-star will not be our Pole-star, but a Star near the Pole of the Ecliptic, round which the direction of the lunar axis revolves once in 18½ years, at a distance of only 1½°. We might take the Pole of the Ecliptic as a sort of mean lunar pole, and, though there is no bright Star there, yet the remarkable planetary Nebula (No. 6543 in Draco) is so near the Pole, that it will serve as a guide for the lunar traveller.

The Zodiacal constellations that occur in the ecliptic will to a lunarian appear in the equinoctial zone. A complete solar lunar day,

or lunation (including day and night), depending upon the Sun, endures for about 29½ of our twenty-four hour days, and makes what we call a Lunar Month. It lasts from New Moon to New Moon. But a revolution, measured by the Stars, lasts only 27⅓ days, a sidereal lunar day, or what we call a Sidereal Month. With us the difference between the solar and the sidereal day is nearly four minutes, but with the Moon-dwellers it is fifty-three hours.

The Stars will seem to travel their orbits about 27 times more slowly than with us. Occultations of a certain zone of them by the Earth will be frequent, and, in the case of a central occultation, a Star might disappear for about 3½ hours. Also, owing to the Earth's atmosphere, there will not be that sudden disappearance and reappearance which we observe in Stars occulted by the Moon. Before Full Earth, the Stars will be occulted by the Earth's dark limb, afterwards by her bright limb.

So slowly does the Moon rotate that a brisk walker, starting at noon in lunar latitude 66° north, and walking from east to west along his parallel, could keep the Sun always in the south, and thus enjoy perpetual noon. If, by cycling, he increased his pace, the Sun would appear to back in the heavens from west to east. A train, starting at noon, and going west at 21 miles an hour along the same parallel, would so gain upon the Sun, that, about 40 hours later, he would appear to set in the east.

The Planets seen from the Moon.

It has already been pointed out that, from the Moon, on account of the darkness of the lunar sky, the Planets will be visible in the day-time. If they had no proper motions, or were infinitely distant, they would rise and set like the stars, being at the equator above and below the horizon for 13⅔ days, and travelling from east to west. But as their distances are finite, and as both they and the Moon are moving round the Sun, their actual movements in the sky will vary much after the same fashion as when viewed from the Earth, only the lunar observer will be able to watch their movements continuously, for a time much longer than we can. It is interesting also to note that, as Evening Stars at greatest elongation, Mercury may be two, and Venus four days, above the lunar horizon after sunset. The superior planets will be able to be seen in opposition and conjunction with respect, not only to the Sun, but also to the Earth. There would of course be a parallactic displacement of the Planets, depending upon the Moon's orbital position, but the maximum amount, even for Venus at her nearest, would be a little less than 31′ 38″, that is less than the mean angular breadth of the Moon as seen from the Earth's surface. For the other Planets the displacement would be smaller, the more distant they are.

The Earth seen from the Moon.

The back of the Moon would in many respects be almost an ideal situation for an observatory, except that we should not be able to see

the Earth. Both sides of our Satellite receive sunlight, but only the front can receive earthlight.

Let us suppose ourselves at the centre of the front face of our Satellite. We see the Earth as a huge disc, some thirteen times bigger than the Moon, and fixed almost immovably in the zenith. The mean angular breadth of the disc will be about 116′, or nearly 2°, with a minimum of 107′ 56″ and a maximum of 122′ 36″. With a telescope the polar compression, about 23″, should be evident. On account of the Moon's librations in latitude and longitude the Earth will not remain absolutely at rest, but will perform small oscillations about her mean position, appearing to describe a series of tiny ellipses.

What we recognise as the Moon's diurnal libration will, to a lunarian, be represented in the form of a movement across the Earth's disc of its different features, a movement due to her axial rotation. The changes in the angular breadth of the Earth are due to the ellipticity of the Moon's orbit, which varies her distance. The Earth's area, when nearest, will appear about one-third larger than when furthest.

If we leave the centre of the face and proceed thence along a lunar meridian to either pole, the Earth's disc sinks gradually in the sky from the zenith, until, as we get close to either pole, the disc will be near the lunar horizon; but this movement is apparent only, not actual, and, when we come to rest, the Earth also comes to a fixed position, and remains there, except for the small oscillations referred to. One writer suggests that a lunarian on the equator, by observing the Earth's altitude, might determine his own longitude.

The Earth's phases will be exactly supplementary to those of the Moon; but the terminator, or dividing line between light and dark, will be sensibly modified by the atmospheric twilight. At our New Moon the lunarians see the whole disc of our Planet; it is Full Earth. At Full Moon the disc will receive no direct sunlight and be very dark; it is New Earth. When we see the Moon half-lit in her first quarter, the lunarians see the Earth, also half-lit, but in her third quarter. Our Earth in fact will be the Moon of the Moon. Assuming the reflective powers of the two bodies equal, then at Full Earth the light sent to the unsunned face of the Moon exceeds about thirteen times the light sent by the Full Moon to us. Thus, at Full Earth, the front of our Satellite will be fairly well lighted up. This illumination occurs only on the face of the Moon. Night upon the other half will be night indeed. During the crescent or decrescent phase of the Earth, the phenomenon of the old Earth in the arms of the new, analogous to that of the old Moon in the arms of the new, might be observed, but would be very inconspicuous, much less conspicuous than the earthshine seen by us; and, as it is always the same face of the Moon that reflects to the Earth sunlight, afterwards re-reflected by the Earth to the Moon, it is obvious that, for a given phase of the Earth, no perceptible variation in this twice reflected light can occur, except by variation in the reflective power of the portion of the Earth's disc turned moonward.

Our Earth will be seen by the lunarians to turn rapidly round her axis once in about 24 hours 51 minutes, on the average; further research showing that 55 minutes of this period are due to the Moon's own motion, and that the Earth's actual rotation, referred to the Stars, takes place in 23 hours 56 minutes, the Earth thus turning about 29.6 times in a lunation, or lunar day and night. M. Flammarion suggests as not improbable that the lunarians may come to the conclusion that the Earth's atmosphere renders her uninhabitable, and that her main purpose is to serve as a timekeeper to the Moon, and as a light to lighten her nocturnal darkness.

With a telescope, when clouds are absent, continents, oceans, snowy mountains and arctic regions, will be clearly visible to the lunarians. The result of a snowfall will greatly interest them. They will also notice the alternating increase and decrease of the white patches about our poles. Such phenomena will be seen by the Moon-dwellers far better than we can discern similar phenomena in Mars, which, when nearest, is still about 150 times further away than the Moon. At the same time it is to be remembered that the Earth's atmosphere, which is much denser than that of Mars, may—even when clearest—interfere to some extent with the distinctness of the view. When clouded, the Earth will look extremely bright, like Venus looks to us, the sunlight being brilliantly reflected from the outer surface. The effect of air-currents, such as the trade-winds, in drifting the clouds, will suggest curious problems, problems very difficult of solution to a people unacquainted with air or water in any form. A great volcanic eruption, like that of Krakatoa in 1883, will arouse intense interest, and, taken in connection with those terrestrial districts in which extinct craters are visible, may throw light upon the origin and history of their own dead volcanoes.

Did space allow, it would be easy to give a picturesque description of our Earth as she revealed herself to the Moon by rotation. There would be no need of a Columbus to discover America, of a Nansen to find the Pole. A few hours would bring the New World into sight, as ocean succeeded continent and continent ocean. Land will be relatively bright, water relatively dark and greenish, deserts yellowish in colour and unchanging, but areas of vegetation might vary in hue with the season. Large rivers and even towns could be discerned, the smoke-pall over many of the latter being of great assistance in localising them. It is of course only at Full Earth, during the lunar midnight, that the whole disc fully lighted up will be revealed. But the Earth, when viewed even during the lunar daytime, will show the illuminated portions of her disc probably as bright as in the lunar night, because of the darkness of the lunar sky. It will be very curious to watch, in a crescent earth, changes of luminosity due to the substitution of land for water and water for land. From the greenish appearance of the lunar earthshine it has been conjectured that perhaps our globe will, on the whole, appear greenish to the Moon.

Dwellers on the Moon, could they be made acquainted with the controversy, would certainly feel astonished at the stupidity of those terrestrial beings who still persist in maintaining that the Moon does not turn on her axis. The lunarians will have continual proof of such rotation in the rising and setting of the Sun and Stars. I am of course assuming that they have got beyond the Ptolemaic lunacy of supposing their world to be the centre of the Universe. If the Earth turned round once a month, we should think it very strange if the lunarians told us that, because we thus presented to them always the same face, therefore our Planet did not rotate at all. The two cases are parallel.

Eclipses seen from the Moon.

The average breadth of the Earth's umbral cone, traversed by the Moon, is 5,700 miles, that of the penumbral cone exceeds 10,000 miles. To a lunarian, while crossing the latter, the Sun will appear partially, while crossing the former, totally, eclipsed; the two cases corresponding to what we see, from the Earth, as partial and total lunar eclipses.

Total eclipses of the Sun by the Earth, visible, not as are our total solar eclipses, at a few favoured spots for a few brief minutes, but seen over the whole lunar hemisphere, and enduring for nearly two long hours, will be of unrivalled sublimity. Encircling like a glory, the huge black globe of the Earth will be a thin line of ruddy atmospheric light (really a very distorted image of the hidden Sun) of twice the depth of sunset, and, fringing this, a light-blue halo. Only by this lurid glare will the lunar darkness be relieved, and this relief would be completely absent had the Earth no atmosphere, and may also be wanting if the air about the earth's limb is full of cloud. During such a solar eclipse there will be an excellent opportunity for spectroscopically examining the composition of our atmosphere.

In striking contrast are the little eclipses of portions of the Earth, over whose sunlit face the tiny black circular or oval shadow of the Moon will be seen winding in a snaky curve, and advancing in its path at a rate, varying from 1,000 to 5,000 miles an hour. The dark umbral section, when circular, may have a maximum breadth of about 170 miles (nearly 150″). The penumbral annulus or fringe of this shadow, extending about 2,000 miles on either side of the umbra, and becoming fainter as it recedes, will be in sight, but not easy to distinguish. Within this penumbra, to a person on the earth, the Sun would appear partially, but to one within the umbra, totally, eclipsed. If, to a dweller on the Earth, a Solar eclipse be annular, then the lunar observer will see, moving over our disc, a penumbra only, darker towards its centre, but never so black as the true umbra. Only from the front of the Moon, the half presented to us, are eclipses visible.

The Moon's Orbit.

Neither from the Sun nor the Earth can we get a clear view of the shape of the Moon's orbit about the Sun. But, if we imagine ourselves

high above the plane of the ecliptic, we shall see that the Moon's path is always concave to the Sun. From her first to her third quarter, the Moon passes through the full phase, and her path is outside the Earth's orbit. From her third to her first quarter, the Moon passes through the new phase, and her path is inside the Earth's orbit, which she crosses at each quarter. Of her own orbit that half, which contains the New Moon, though less curved than the other half, is still concave to the Sun. The concavity towards the Sun varies, but never, even at New Moon, vanishes. The Moon, in fact, behaves far more like a Planet of the Sun than a Satellite of the Earth, and, if the Earth ceased to exist, the Moon's orbit would alter but little. The two bodies form a sort of double Planet, and remind us of a double Star. The Moon's velocity about the Earth is only about one-thirtieth of that of the latter about the Sun, so the Moon must possess the Earth's velocity as well as her own, or she would be left behind. If the Earth's orbit be represented by a circle, 33 feet in diameter, the Moon's path deviates from it only by about half an inch either way.

The theoretical prediction of the exact position of the Moon, perhaps the most difficult problem in Astronomy, is not even yet completely accomplished, the difference, between the declination observed and that calculated, amounting, in 1894 at Greenwich, to nearly half a second of arc, that is to about half a mile at the Moon's distance.

Conclusion.

As M. Flammarion concisely states—"The Moon is the world of "yesterday, the Earth of to-day, Jupiter of to-morrow." In all probability the Moon was derived from the Earth, and it may be that she prefigures the decay of our Planet, points onward to a time when—

" . . . . this outworn Earth be dead as yon dead world the Moon.
" Dead the new Astronomy calls her, ...
" Dead, but how her living glory lights the hall, the dune, the grass!
" Yet the moonlight is the sunlight, and the Sun himself will pass."—*Tennyson.*

Why does our Satellite turn to us always the same face? So long ago as 1754, the Great German Philosopher, Immanuel Kant, divined the answer. In times inconceivably remote, when the Moon was molten or plastic, powerful tides would be raised in her by the Earth. Acting like a great friction-brake, these tides would reduce her rate of axial rotation until it was in exact agreement with her orbital velocity. In other words, the sidereal lunar day was made equal to the sidereal lunar month. The coincidence is startling enough, and would be quite inexplicable were we not able to assign for it some physical cause. It seems also not improbable that a similar coincidence of period, similarly caused, may obtain between Primary and Satellites in the systems of Jupiter and Saturn.

The past present and future history of the Earth-Moon system, as expounded by Professor George Darwin, though profoundly difficult, is

of surpassing interest and wide application, for its expansion involves the general theory of Planetary Evolution under tidal influence. We stand on the brink of a new era, undreamt of by the talented author of the *Mécanique Céleste.* In Miss Agnes Clerke's eloquent words:—"To "those coming after us our knowledge will appear almost ignorance, yet "it is not to be despised, since by it we reach up groping fingers to "touch the hem of the garment of the MOST HIGH."

[NOTE.—To Mr. A. Crommelin, of Greenwich Observatory, and Mr. G. Atkinson, of Cardiff, I am much indebted for independent confirmation of many of the numerical details.]

Llandaff Cathedral Precincts.

By CLEMENT WALDRON,

Registrar of the Llandaff Probate Court.

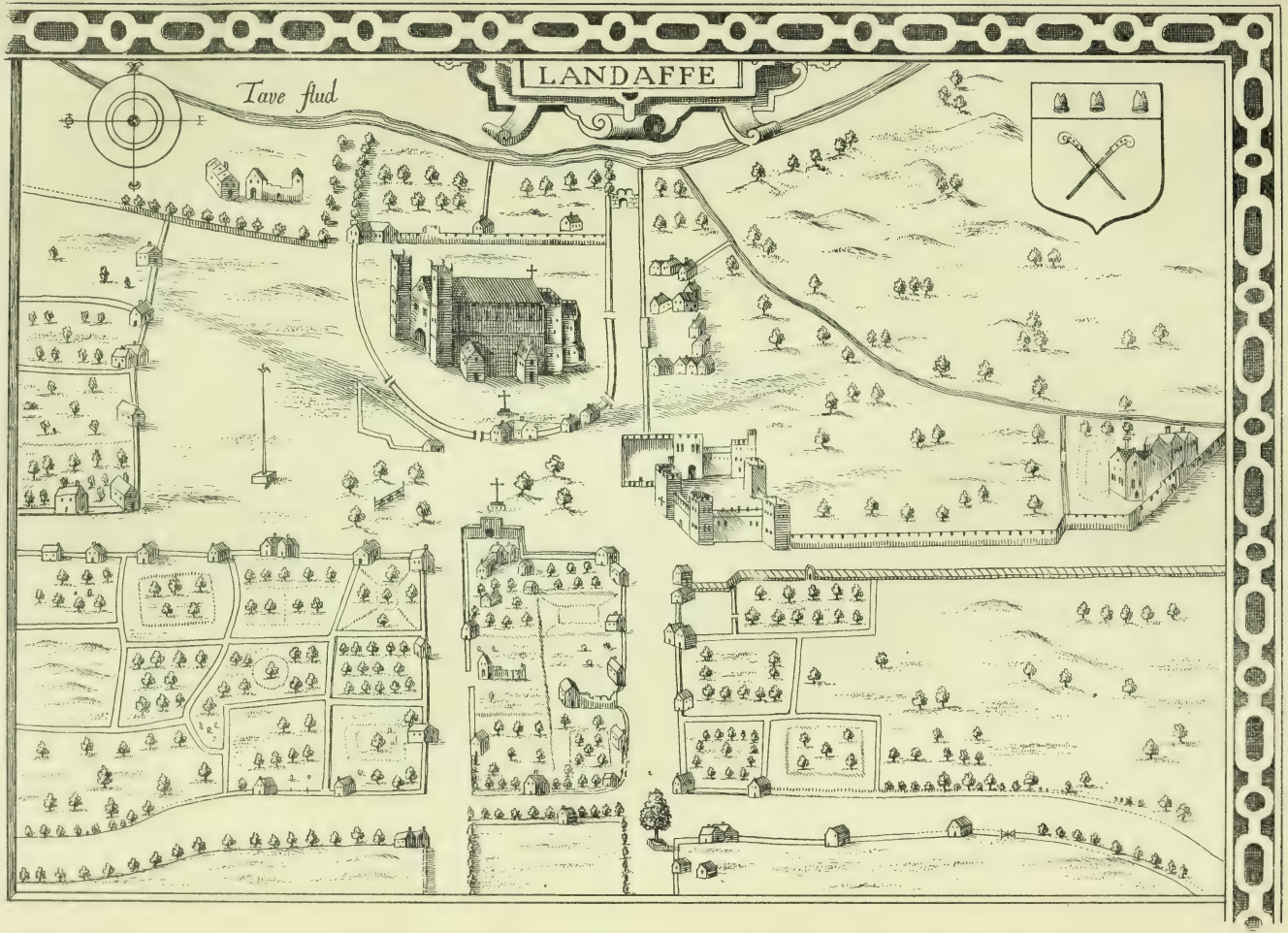
WHILE much has been written about the fabric of the Cathedral at Llandaff, very little appears to have been recorded of the many ecclesiastical buildings which formerly stood around it. I have, therefore, endeavoured, with such material as I have been able to collect, to put together a few notes on the Cathedral precincts, in the hope that others may be able to supply further information.

The accidental discovery of some fragments of 15th century pottery —a curious Gargoyle—a coin of Edward IV., and other objects of antiquity, by a workman, in digging a drain in the garden in my occupation near the Cathedral, has led me to endeavour to trace some of the old buildings with which the Cathedral was surrounded.

It will be seen by the copy of Speed's Map of Llandaff, published in 1676 (which accompanies this paper), that nearly the whole of this garden was covered with houses, in which the Clergy and Cathedral Staff resided.

There seems little doubt that, in the 14th century, the Cathedral was surrounded by many such buildings, but all traces of them are now nearly obliterated, and the only account of them which I can find is contained in Browne Willis' Survey of the Cathedral, published in 1716, and Bishop Godwin's catalogue of the Bishops of Llandaff, published about a century previously.

The most important of the ecclesiastical residences was the castle. It was here that the early Bishops resided, and exercised both temporal and spiritual jurisdiction over the large territory which they possessed.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The castle was probably erected by Urban, at the same time that the Cathedral was built by him, in the early part of the 12th century.

It must have witnessed many of the disturbances which occurred in this part of Wales during the next three centuries, until it was destroyed by Owen Glendower, when he rose in arms against Henry IV., at the commencement of the 15th century.

It was subsequently alienated with the manor of Llandaff, from the See, and passed into the hands of the "Matthew" family, with a large tract of land between the rivers Taff and Ely, but it was never restored.

The fine gateway and gate-house and wall still standing, are evidence that it was a very stately building during the time when it was occupied by the bishops.

The pottery, and other fragments, which I have mentioned, were found buried about 4 feet deep in the ground, at the south of the house of the Prebend of Worthacwm, facing the castle, and may, possibly, have been thrown down there at the time of the demolition of the castle, or, indeed, have been deposited where they were found, when the house of the Prebend of Worthacwm (part of which now forms a portion of the cottage occupied by my gardener), fell into decay.

The Gargoyle is a curious and grotesque head, carved in Dundry stone, and is quite different in character to the Gargoyles which were removed to the Bishop's garden during the recent restoration of the Cathedral.

The crest, or ridge tiles, are covered with a green metallic glaze, and are similar to those found in several old priories at Great Malvern, at Cardiff, and in Gower.

With the tiles were found small round pipes of the same glazed pottery. They appear to have been fixed in the crest, to break the line of roof, and to have held crosses, or other emblems of the Christian faith.

Tiles of this description are stated to have been made at "Abbas Repton," but it seems probable that the potters who made them went to places where they were required, and where the requisite clay could be found, and made and burnt them on the spot. The marks on the tiles are evidence that they were made by a guild, or family of workmen, skilled in that art.

The pottery also is of very early date, and some of it contains the metallic glaze which appears on the tiles. It consists principally of fragments of jugs and basins, and a pilgrim's bottle.

Perhaps the most interesting object which was found was a mould, or matrix, for making leaden crests. It is made of either Dundry or Sutton stone, and shews the grooves through which the lead was poured to form the crest.

In the early part of the last century (according to Browne Willis), and no doubt appearing in the old Act Books, the Chapter of Llandaff consisted of fourteen members—a Bishop, who was also Dean, an Archdeacon, and twelve Prebendaries. There were also two spiritual Vicars Choral, of whom one had a pension of £20 a year, and the other had the small tithes of Llandaff and Whitchurch.

The service of the choir, however, had been put down many years, and the revenues thence arising appropriated to the reparation of the edifice, of which the roof was falling in, and destroying the whole church.

To the east of the Cathedral, under the walls of the castle, stood the house of the Prebend of Worthacwm, and next to that the treasurer's house, and further on, the College of the vicars choral, and other officers of the church.

Towards the north-east end of the church-yard, at this period, stood the Prebendal house of William Jones, next to that the Prebendal house of St. Andrew, and beyond that, the house of the Prebendary of St. Crosse. All these houses were without the burial ground of the Cathedral, but little or no trace of them now remains, and the ground on which they stood was added to the burial ground during the last restoration.

The boundary may still be traced by the line of stones shewing the portion added.

The only Prebendal house now standing is near the north corner of the church yard. It was rebuilt in the early part of the last century, and fitted up for the reception of the Chapter, and in an upper room of this house, according to Browne Willis, was a small library founded by Bishop Davies, which has probably been removed to the present Chapter house. Among the books were many of the Fathers' from the 2nd to the 8th century, "a very fair St. Chrysostom, of the Eton edition, "with Bellarmin's controversies, and several of the classics." In all forming good stiff reading for the clergy.

There had been a more important library in the church before the Civil Wars, but it was dispersed by the rebels, and part of it burned, with a great heap of Common Prayer Books, at Cardiff.

At this time it is supposed that some of the old wills, which were kept in the Cathedral, were also burnt, with records of the Consistory Court. Some of the old books in the Probate Registry show signs of having been rescued from the fire.

Towards the north-west of the Cathedral, opposite to Jasper's Tower, in a field called Llan-y-wrach, Browne Willis mentions a ruined piece of building, having the form of a castle, and said to have belonged to the Archdeacon of Llandaff. He concludes that this dwelling must have been very "magnificent," for the "Archdeacon in Henry IInd's "time, entertained that Prince at dinner at his own house, from whence "he went to Cardiff Castle, where he supped and lay that night, on his "return to London from his wars in Ireland."

This castle, together with the Bishop's castle, is said to have been destroyed by Owen Glendower. A small portion of the former was standing about forty years ago, and was used as a cowhouse by the late Mr. Huckwell, the Registrar of the Probate Court, which was then held in an ancient building, pulled down about that time, to make way for the present deanery.

Before the lands belonging to the Cathedral were taken away by the Ecclesiastical Commissioners, the Dean and Chapter were accustomed to entertain their tenants, and some of their neighbours, at an early dinner given in the Prebendal house on St. Peter's day. On those occasions, Lord Tredegar, or Mr. Augustus Morgan (the latter being one of the tenants), sent a handsome present of venison for the dinner. There are some few now living who can recall many of these dinners, and the clever, interesting speeches of Dean Williams, who presided.

Of the Prebendal residences, the most important appears to have been that of Worthacwm. It has a very ancient history.

The Liber Landavensis, which is said to have been compiled in the 12th century by Jeffery, the brother of Bishop Urban, contains the following account of the endowment of the Prebendary of Gwarthaf Cwm, supported in part by the tithes of Llangwm. "Caradoc, son of "Rhiwallon, lying in sickness, and being mindful of the salvation of his "soul, and of his evil deeds, and especially with respect to his brother "Cynon, who was killed by one of his companions at the suggestion "and instigation of the devil, in his presence and for the most part on "his account, and for this penance suitable to the crime had been "enjoined him, and he had gone seven times to the church at St. Peter. "Knowing that he could not otherwise be saved but by fasting, prayer, "and almsgiving, granted to God, and to St. Dubricious, St. Teilo, and "St. Oudoceus, and to all Bishops of Llandaff for ever, the village of "Gunnhuc, of his own inheritance of Gwartha Cwm."

The record goes on to describe the boundaries of this grant, which are discernable to this day; as for for instance, Nant-y-March, a brook which runs through the parish of Llangwm.

Judging from the thickness and extent of the walls which have lately been uncovered, this Prebendal residence must have been a large building, extending towards the east, and containing several large apartments, with outbuildings attached.

The treasurer's house, which adjoins to the north, was also a large building, and at the beginning of the century was used as a tithe barn. The fireplace, and one or two small windows, still remain.

In the reign of Henry VIII., one, John Gryffyth, was treasurer and, probably, resided there. He must have witnessed the spoliation of the Cathedral plate, with the silver shrine and saints' heads, with their mytors, the chalyces, sacring bells, and other silver articles mentioned in the list of church goods [confiscated by the Lord Cromwell, the King's secretary], now in the Record Office, of which a copy accompanies this paper.

The whole of the plate is set out in the declaration of Morice Mathew of Landaf, but only a portion of it appears to have been surrendered; nothing is known of the remainder. It may now be buried in the ruins of the treasurer's house.

Of the College of the Vicars Choral, scarcely anything remains. The north wall was pulled down when the new cemetery was laid out,

and the new wall of the garden built. In the garden, however, the foundations of the building have been discovered, several feet below the surface, and by the mill stream a portion of the wall still remains.

The other Prebendal houses to the north of the Cathedral have entirely disappeared, but about 40 years since, the house of the Prebend of St. Crosse, converted into a cottage called "The Cwm," was still standing.

The Bell Tower [of which some of the walls are still visible], on the rising ground to the left of the Lych Gate, must have been a building of some importance, for it held a fine peal of bells, of which the large tenor bell now hangs in the Cathedral at Exeter, removed from Llandaff by Bishop Courtenay.

On the opposite side of the green, at the corner of a street called "Heol Fair," was a building which was probably connected with the Cathedral. It was quite a ruin, and was pulled down about 30 years ago—the accompanying photograph was however preserved.

In the same street stood a building, called the "Black Hall." A portion of the ruin is now standing. It was probably the Hospitium, or house in which travellers were entertained.

I have endeavoured to collect such information as was available respecting the buildings in the Cathedral precincts, but beyond a few ruined walls and broken vessels, nothing remains to suggest and enable us to realize the mode of life and habits of the generations of Clergy connected with the Cathedral, who dwelt in them during the long period of years in which they were habitable.

This offers an opportunity to add some account of the various stages of the restoration of the Cathedral during the last 100 years. Towards the latter end of the last century it was proposed by some residents in Cardiff to raise a fund to repair, if not to restore the Cathedral, and Bishop Watson (then Bishop of Llandaff), the author of "The Apology for the Bible," and "The Reply to Tom Paine's Age of Reason," was applied to, and wrote the following letter, which is in my possession :—

"CALGARTH PARK. THENDALE. *June 22nd 1799.*

"SIR.

"The funds of Llandaff Cathedral are so scanty that they are insufficient for "the support of the Fabric, to which purpose they ought in the first instance to be "applied. Some years ago they were so exhausted that the Great Tower there must "have remained in ruins had I not given forty pounds towards its reparation. "Under these circumstances I fear that your proposal (though very creditable to "Yourself and useful to the Church) cannot be complied with.

"I shall however submit the matter to the Archdeacon and Chapter and shall "readily acquiesce in their determination.

"I am, Sir,

"Your faithful Servant.

"M. LLANDAFF."

Old House at the Corner of St. Mary Street.

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An account of the various restorations or repairs which had been executed before the episcopate of Bishop Watson will be found in Bishop Ollivant's book on the Cathedral, published in 1859.

On the 16th April, 1857, the Cathedral was re-opened for public worship, and a remarkable sermon (which some of us may remember) was preached by the Bishop of Oxford. The work of restoration had been going on during the preceding 10 years, and £9,000 had been expended in restoring the presbytery, the choir, and the unfallen portion of the nave and clerestory, the restoration of the roof and opening out the beautiful Norman arch between the nave and the eastern chapel. Of this sum £3,348 was contributed by the then late and present Bishop and by individual members of the Chapter.

In the following years, 1858 and 1859, £4,232 were expended in repairing the arcade, the aisles, portion of southern tower, re-construction of clerestory and slating the roof.

In the years 1860 and 1861, £2,400 was spent in further restoration of the nave, repairing the western front, and the windows, and in the choir and Bishop's throne.

In addition to this, £1,000 and upwards was subscribed towards an organ, and a full choral service was celebrated on the 17th September, 1861.

In the years following up to 1867, the work of restoration went on, and further sums were subscribed by the friends of the Church, and laid out in the reredos, the stalls, sedilia and other works.

In 1867 the re-building of the south-western tower was commenced, and new battlements placed on the northen tower. The cost of these works was more than £8,000.

Towards the restoration of the Building, up to the last-mentioned date, at least £25,000 were subscribed by members and friends of the Church, and that which 40 years since was a roofless, ivy-covered ruin, is now the beautiful Cathedral of which we, as Churchmen, are so justly proud.

During the last 25 years further sums have been expended on the bells, on Rosetti's paintings over the altar, the underpinning of the south tower, which threatened to fall into the Cathedral, and in other works, and it may safely be estimated that more than £30,000 has been laid out since the restoration of our ancient Cathedral Church was commenced.

To whom then must the credit be given for having inaugurated this pious work?

In a speech delivered at a meeting held at Cardiff in October, 1843, by the late Rt. Honorable John Nicoll, then M.P. for Cardiff, followed by other speeches from the Reverend George Thomas, and Bishop Ollivant, the Clergy and Laity were roused to contribute to the work, and a circular published by Dean William Bruce Knight met at once with a hearty response.

In 1845, the work was taken up by Dean Coneybeare, and to him succeeded Dean Williams, to whose untiring zeal and energy the final completion of the work must be attributed.

PUBLIC RECORD OFFICE.

LAND REVENUE RECORDS [*Removal of* 1872.]
Church goods Bundle 1393, *file* 181, *No.* 1.

SOUTH WALES. Declaration of Morice Mathewe of Landaf Esqre concerning the plate which remained in the Church at Landaf.

Taken by Sir Henry Morgan and brought to London to be delyvered to the Lorde Crumwelle he harde say.

One Shryne of St. Tillier of silver.
12 Apostles of silver with the Trinitie.
St. Elios hedde of silver gytte.
St. Dulrice hedde of silver an arme of the seid Seynte of silver.
St. Odythe his hedde of silver and an arme of seid Seynte.
A crosse of golde about half a foote of length.
Item 11 other crosses of silver.
A pixe and 11 Candelstyckes of silver.
11 barons of silver 11 Crewetts of silver.
A paxe of silver. A little sacring bell of silver and a shippe to carry Frankingsence of silver 11 Sencers of silver Item xiii.
Challesses of silver.

MYLES MATHEWE,
South Wales.
Church goods.

PUBLIC RECORD OFFICE.

LAND REVENUE RECORDS. *Church Goods.*
Bundle 1393. *File* 178. *No.* 1.

Accounte of George Herbert, Rice Manxell Knight, Robert Gamage Commissioners of our late Sovrayen Lorde King Edward . . . . for the sale of the Church goods within the Countie of Glamorgan made the viiith December annus regnori Phi et Marie re tertio et quarto. Returned to the Right Worshipfull William Barnes, Thomas Meldma, St. John Wesman Esqres Commissioners.

William Herbert, William Bassett, St. Myles Mathewe Esqres Commissioners allotted to the hundred of Kaerfilly, Llantrissent, Denys Powis and Kaerdif to receive the money and Churche goode of the sayd foure hundred.

Item the sayd Wm Herbert rece vii Challices with their patents pcell glitte weyinge lxxi ownce. And also recd out the Cathedral Church of Landaf one sencer of silver ffoted with brasse weighing xxv ownce. 1 Paxe of silver with a cristall stone in hit, weighing viii oz Half a shippe of silver weighing ix ownce, a bell of silver gilte weighing v ownce all which plate amounted to a hundred xix ownce.

Which plate the sayde William Herbert detayneth till the further pleasures of the Lords of the Prevey Counsaill be known.

Item the said William Herbert receaved one Chesyble of tynsill belonging to the Church of Landaf.

GEORGE HERBERT
ROBERT CAMAGE
MYLES MATHEWE
R. MANXELL
WILLM. HERBERT
WILLM. BASSETT

PUBLIC RECORD OFFICE.

LAND REVENUE RECORDS. *Church goods.*
Bundle 1393. *File* 182. *No.* 1.

Mr John Broxholme Gentleman had the Shryne of Seynt Jobyce in Landaf and the iii Seynts hedds with their Mytors on silvered and doble gylte.

The plate & juels of Landaf.

Item Doctor Smyth now Archdeacon of Landaf and some time Tresorer then had all the rest of the Juols Plate and stuff of the sayd Cathedral Church of Landaf. John Gryffyth now Tresorer was prevy to all the sayd spoyle don by Doctor Smyth forsayd.

PUBLIC RECORD OFFICE.

LAND REVENUE RECORDS. *Church Goods.*
Bundle 1393. *File* 180. *No.* 1.

The sayd John Broxholme saythe that aboute the xxxii or xxxiii yeres of the raygn of our late Sovraygn Lorde King Henry the eight one Robert Holgate, then Busshoppe of Landoph and the Chapter of the Cathedral Church of Landoph were possessed of one Shryne called Saynte Tyasez standing in ye sayd Cathedral & one Henry Morgan, St. John ap Jevan & other Chanons resydencyaryes of the sd Cathedral hearing that the sayd late King of famous memory had sent for dyvers Shrynes which stood in other Churches such as Lyncoln Canterbury & divers other dyd pull downe the sayd Shryne and brake hit in many pieces and convayde them away to their own usez. Whereupon Thomas Baker Comyssary to the Busshoppe of Landoph informed the sayd Bishop who advertysed the Lord Cromwell thereof by Doctor Bellyces whereupon the said Lord Cromwell commanded the sayd Busshoppe that he should send to the sayd Chapter for the sayd Shryne to be brought to London whereupon the sayd Chapter in the Chapyter House of the Cathedral and the Canons residentiary delivered unto me about four or fyve hundred ownces of glytted plate which they said was their hole Shryne, which plate was brought by me to London and deliveted to the sayd Busshoppe who afterwards sold the same io one Rede a Goldsmythe in Chepsyde.

Afterwards the sayd late Bishop gave and sent unto the sayd Cathedral Church a payre of Organs and dyvers suytes of vestments as he sayd in recompense of the sayd Shryne.

And further the sayd John Broxolme sayth that the sayd Cathedral Church of Landoph never was surrendered dissolved or come into tbe possession of the sayd late King Henry the eight but still remaynes in her ancenceyatt body poltyque and that King Henry the eight nor no other King or Quene of this realm were never seized of the same Church since the tyme out of mynd of any estate of freehold nor yet entytled to have the gooddes and chattals of the sayd Churche.

The answer of Mr Broxholme.

The Meteorology and Kindred Phenomena of 1895.

By FRANKLEN G. EVANS, F.R.A.S., F.R. Met. Soc., &c.

THE weather is a never-failing topic of interest to every true-born Briton, and he regards it as his special privilege to grumble at its fickle and inconstant character, and the perverse way in which it often spoils his crops, and mars his best-laid schemes of outdoor amusment. His latest experience in this direction, was a lively exercise of the imagination, but on the whole soothing to his temper, and productive of feelings of pleasure, rather than otherwise, and not disagreeable in the retrospect. The year 1895, with its many changes and extreme variations, glided through its seasonal phases with an unusual intensity of character, and left on the senses of the million a vague impression of wonder and bewilderment at the force and vigour of its many-sided attributes. It passed before men's eyes and minds like a great panorama of the climates of the world, in which they seemed to see the frost, ice and snow of the northern regions; the heat of the burning plains of India, with an occasional splash of its rainy season; destructive tempests, and all within the temperate region of the British Isles. While this vivid pictorial display still lingers in the sunny fields of memory, we will endeavour to study its details and varied composition, to depict with the pen of the writer rather than the brush of the painter the most noteworthy views of this great meteorological landscape, and print and fix them permanently in the pages of the Transactions.

The principal characteristics of each month are given in the following summary :—

JANUARY was a very cold and rigorous month, with hard frost alternating with cold rains. E. and N. winds predominated, and the force amounted to a moderate gale on the 13th. The barometer was low and fluctuating. The maximum height, 30·45 inches, was attained on the 30th, and the minimum, 28·84 inches, on the 14th, showing a range of 1·61 inch. The instrument was below 30 inches on 25 days. The mean degree of humidity was 82, complete saturation being represented by 100. The rainfall was 4·04 inches, distributed over 19 days. Ozone was strongly developed, the mean degree 6·548. The mean heat was 34 0 degrees, which is 2·9 degrees below the Greenwich average of 50 years without correction. There was frost on 23 days, very severe during the last week. There was snow to a depth of five inches. The air movements were mainly anticyclonic until the 10th, then cyclonic up to the 26th, when a deep anticyclone commenced.

FEBRUARY was a remarkable month, with severe and almost constant frost and drought. Extremely cold E. and N. winds preponderated, but of generally light force. The barometer was very high and steady. The maximum height, 30·46 inches, was reached on the 17th, and the minimum, 29·75 inches, on the 10th—range only ·71 inch. The mercury was above 30 inches on 16 days. The air was dry—mean degree of humidity only 71. Rainfall was almost entirely absent—only ·011 was measured on the last day. Ozone was abundant—mean 5·178. The average temperature was down to 29·9 degrees—nearly 9 degrees below the mean. Frost was severe and continuous, and occurred on every night but two. The lowest temperature in the shade was 13 degrees on the 9th, but the reading on the grass was much lower. The anticyclone that began on the 27th of January continued throughout the month.

MARCH was a month of much softer character, with adequate moisture. S.W. winds prevailed. A violent gale occurred round the 24th and did much damage. The barometer was low and unsteady. The maximum height, 30·40 inches, was recorded on the 15th, and the minimum, 29·10 inches, on the 27th—range 1·30 inch. The reading was below 30 inches on 22 days. The air was moist—mean degree of humidity 85. The rainfall was abundant—3·99 inches—spread over 15 days. The greatest fall in 24 hours was 1·06 inch on the 23rd. Ozone was ample—mean degree 5·613. The mean heat was 43·1 degrees, which is 1·5 degree in excess of the average. There was frost on 13 nights, chiefly in the first half. The anticyclone of the previous month continued until the 5th, and then gave place to a cyclone that lasted seven days. Another anticyclone ruled until the 22nd, and this was followed by the deep cyclone which caused the heavy gale. The coltsfoot bloomed on the 7th, hazel on the 12th, and wood anemone on the 23rd. The song thrush was first heard on the 5th, honey bee seen on the 11th, and wasp on the 22nd.

APRIL was mild and equable, generally fine, and with a rather light rainfall. N.W. winds of moderate force were in excess. The barometer was of medium height and limit of oscillation not excessive. The maximum reading was 30·44 inches on the 12th, and the minimum 29·43 inches on the 7th—range 1·01 inch. The pressure was under 30 inches on 18 days. The air was rather moist—mean degree of humidity 80. The rainfall was 2·87 inches, divided over 14 days. Ozone was abundant—mean degree 6·533. The mean heat was 49·6 degrees—3·4 degrees above the average. There was slight frost here on the 1st, but none afterwards. The air movements were mainly cyclonic until the 9th, then anticyclonic to the 16th, cyclonic until the 27th, and anticyclonic to the 30th. The blackthorn blossomed on the 19th, the garlic hedge mustard on the 22nd, and horse chestnut on the 30th. The swallow was first seen on the 10th, and cuckoo heard on the 19th. The small white butterfly was observed on the 28th, and orange-tip on the 29th.

MAY was a remarkably fine, sunny, bright month, but injuriously dry. N.E. winds of light force predominated. The barometer was very high and steady. The maximum height, 30·64 inches, was registered on the 2nd and 3rd, and the minimum, 29·75 inches, on the 19th, range 0·89 inch. The record was above 30 inches on 22 days. The mean degree of humidity was only 70. Rainfall was extremely light—almost *nil*—it measured merely 0·33 inch, and fell on two days. Ozone was rather scanty—mean degree 4·484. The mean temperature was 57·5 degrees—4·6 degrees above the average. The greatest heat in the shade was 82 degrees on the 30th, which was very high for the time of year. A steady anticyclone held sway throughout the month, hence the brilliant weather. The hawthorn bloomed on the 10th, white ox-eye daisy on the 20th, and dog rose on the 31st. The nightingale was heard on the 1st. The flycatcher was seen on the 19th, and the meadow brown butterfly on the 23rd.

JUNE was another brilliantly fine, hot and dry month. N.W. winds of light force preponderated. The barometer was again very high and steady. The maximum height, 30·51 inches, was attained on the 24th, and the minimum, 29·75 inches, on the 30th, range 0·76 inch. The instrument stood over 30 inches on 23 days. The mean degree of humidity was again 70. The rainfall was very light—0·88 inch—distributed over five days. Ozone was deficient—mean degree 3·000. The temperature ranged from a maximum of 83 degrees on the 25th, to a minimum of 42 degrees on the 12th and 16th. The mean heat was 62·1 degrees—2 8 degrees above the average. An anticyclone persisted steadily through the month, except on the first and last four days. The black knapweed blossomed on the 14th, and greater bindweed on the 23rd.

JULY was a month of mixed character, with alternations of sunshine and rain. The winds were W. combined with S. all through the month. The force was moderate. The barometer was rather low, but limit of fluctuation not extreme. The maximum height, 30·34 inches, was

reached on the 6th, and the minimum, 29·51 inches, on the 21st, range 0·83. The mercury was below 30 inches on 17 days. The mean degree of humidity was 75. Rainfall was copious, and measured 4·03 inches. It was spread over 15 days. Ozone was rather scanty—mean degree, 3·967. The maximum temperature was 79 degrees on the 8th, the minimum 44 degrees on the 5th, range 35 degrees. The mean heat was 62·5 degrees—0·7 degree above the average. Cyclonic movements ruled the month, except on the last three days. The harebell blossomed on the 12th.

AUGUST was wet and disagreeable, and a great contrast to May and June. S.W. winds of rough quality much prevailed. Barometer was rather low, but the limit of oscillation not excessive. The maximum height, 30·35 inches, occurred on the 25th, and the minimum, 29·40 inches, on the 4th—range, 0·95 inch. The reading was below 30 inches on 16 days. The mean degree of humidity was 76. Rainfall was heavy and continuous. It measured 4·91 inches, and was divided over 21 days. Ozone was fair—mean degree, 4·419. The mean heat was 61·8 degrees—0·6 above the average. There was thunder occasionally. Cyclonic movements dominated the first half of the month, and mixed conditions afterwards.

SEPTEMBER was an extraordinary month, beautifully fine and warm, and not too dry. S. and E. winds of light force were prevalent. Barometer was high, and very steady. The maximum height, 30·42 inches, was recorded on the 20th, and the minimum, 29·85 inches, on the 11th—range, only 0·57. The pressure was over 30 inches on 27 days. Mean humidity was 76. Rainfall light, 1·69 inch, distributed over eight days. Mean ozone, 4·066. The mean heat was 61·9 degrees—5·3 above the average. The maximum temperature in the shade was 81 degrees on the 9th, and it touched 80 as late as the 24th. The air movements were chiefly anticyclonic all through the month. The ivy bloomed on the 20th.

OCTOBER was rough, cold, and rainy. W. and N. winds, sometimes of much force, held sway. The barometer was low, and limit of fluctuation wide. The maximum height, 30·54 inches, was registered on the 18th, and the minimum, 29·30 inches, on the 3rd and 9th—range, 1·24 inch. The instrument was under 30 inches on 19 days. The mean degree of humidity was 83. Rainfall was heavy, 4·41 inches, spread over 14 days. Ozone was abundant—mean degree, 5·548. The mean heat was 47·3 degrees—2·9 degrees below the average. There was sharp frost on seven nights. A marked cyclonic disturbance occupied the first nine days, then an anticyclone, which lasted eleven days, with a fine break in the weather, and mixed conditions concluded the month. Swallows were last seen on the 12th.

NOVEMBER was very wet, warm and stormy. S.E. winds of considerable force predominated. Barometic pressure was low, with a wide limit of oscillation. The maximum height, 30·38 inches, was reached on the 1st, and the minimum, 29·16 inches, on the 12th, range 1·22 inch. The mercury was below 30 inches on 19 days.

The air was moist, mean humidity 87. Rainfall was heavy, 5·10 inches, and it fell on 22 days. Ozone was highly developed, mean degree 6·266. The mean heat was 47·4 degrees, 4·3 degrees in excess of the average. Frost occurred once. The air movements were generally cyclonic.

DECEMBER also was wet and windy and still mild. N.W. winds preponderated, often of much force. Barometer was low and fluctuated widely. The maximum height, 30·27 inches, was recorded on the 28th, and the minimum, 29·03 inches, on the 16th, range 1·24 inch. The pressure was below 30 inches on 20 days. The air was damp, mean humidity 89. Rainfall was heavy, 4·12 inches, and widely spread over 25 days. Ozone was abundantly generated, mean degree 6·774. The mean heat was 39·9 degress, slightly above the average. There was frost on 11 days. Cyclonic movements were in the ascendant.

The principal features of the year are analysed and summarised in following table :—

ANALYSIS AND SUMMARY OF THE METEOROLOGY OF 1895.

WIND-DIRECTION, BAROMETER, RAINFALL, &c.; OZONE AND TEMPERATURES.

1895.	More or less Westerly—Days.	More or less Easterly—Days.	Combined with Southerly—Days.	Combined with Northerly—Days.	Barometer below 30 inches—Days.	Mean degree of humidity.	0·01 in. or more of Rain fell—Days	Rainfall Total—inches.	Maximum fall in 24 hours.	Mean degree of Ozone.	Maximum temperature.	Minimum temperature.	Total range.	Greatest daily range.	Least daily range.	Mean daily range.	Mean of maximum temperatures.	Mean of minimum temperatures.	Mean temperature of the month.	Difference from average of 50 years.
January	12	16	11	19	25	82	19	4·04	0·69	6·548	53	19	34	20	2	10·7	39·4	28·6	34·0	—2·9
February	3	25	4	15	12	71	1	0·11	0·11	5·178	50	13	37	23	5	12·9	36·4	23·5	29·9	—8·8
March	23	6	15	11	22	85	15	3·99	1·06	5·613	64	24	40	24	9	16·9	51·6	34·7	43·1	+1·5
April	17	12	13	16	18	80	14	2·87	0·74	6·533	64	32	32	27	5	16·5	57.8	41·3	49·6	+3·4
May	11	18	12	15	9	70	2	0·33	0·27	4·484	82	36	46	33	11	23.2	69·1	45·9	57·5	+4·6
June	18	11	9	20	7	70	5	0·88	0·53	3·000	83	42	41	37	16	24·3	74·2	49·9	62·1	+2·8
July	31	—	15	11	17	75	15	4·03	0·83	3·967	79	44	35	30	11	18.8	71·9	53·1	62·5	+0·7
August	27	4	21	4	16	76	21	4·91	1·21	4·419	79	42	37	28	12	19·1	71.4	52·3	61·8	+0·6
September	14	16	23	5	3	76	8	1·69	0·54	4·066	81	43	38	30	6	20·1	71·9	51·9	61·9	+5·3
October	19	12	3	22	19	83	14	4·41	0·95	5·548	68	25	43	29	5	16·5	55·6	39·1	47·3	—2·9
November	14	16	19	9	19	87	22	5·10	0·95	6·266	61	31	30	22	1	11·5	53·1	41·7	47·4	+4.3
December	18	13	10	18	20	89	25	4·12	0·58	6·774	54	26	28	18	—	9·6	44·8	35·1	39·9	+0·1
Totals and Means	207	149	155	165	187	79	161	36·48	8·46	5·200	*83	†13	70	‡37	§0	16·7	58·1	41·4	49·7	+0.7

* June 25th. † February 9th. ‡ June 16th. § December 25th.

In this table the first two columns show the number of days on which the winds were westerly and easterly respectively. The third and fourth columns give the proportion in which southerly and northerly currents were combined with the other two directions. The figures indicate a large excess of westerly winds, with a slight preponderance of northerly in combination. The barometer rose to a rather high point at times, and showed a considerable depression at others, with a wide limit of fluctuation. The maximum height, 30·64 inches, was attained on May 2nd and 3rd, and the minimum, 28·84 inches, on January 14th, showing a total range of 1·80 inch for the year. The instrument stood below 30 inches on 187 days.

The amount of moisture in the air was slightly below the average on the year, but it varied greatly. The highest monthly mean was 89 in December, and the lowest, 70, in May and June. The mean degree of humidity was 79, complete saturation being represented by 100. Rainfall in 1895 was light and remarkable for its erratic and fitful distribution as to season and locality. The amount was below the average of the past 10 years, which period, however, was one of small precipitation, and 1895 adds another to the list of unusually dry years. The driest months were February, April, May, June and September; and the wettest were January, July, August, October, November and December. The total rainfall at Llwynarthan measured 36·48 inches, which is equal to 3·684 tons or upwards of 15,248 hogsheads to an acre. The number of wet days was 161, which is 22 days less than the mean of 10 years, and absolutely the lowest in that time, except that of Jubilee year, when it was 148. The sum of the maximum falls in 24 hours was 8·46 inches, which is roughly about one-fourth of the grand total. This is in accordance with the general rule that seems to govern the relation between the total of the greatest falls in 24 hours and the entire quantity. In dry years the proportion is large, about one-fourth, and in wet ones, one-fifth and one-sixth; in fact, the sum of the heavy falls is in inverse ratio to the grand total. I think this holds good, too, for places of naturally light rainfall, such as London, &c. The rainfall in the Society's Field for 1895 is given in the following table, arranged in the order of elevation above the sea level.

1895.	Feet above Sea Level.	Inches.
C. H. Priestly, Taff Fawr	1328	72·12
G. A. Lundie, Bargoed	1237	42·26
Wm. Jones, Castell Nos, Pontypridd	1110	48·57
George Palmer, Penwyllt, Brecon	1108	61·16
Edward Martin, Gwernllyn, Dowlais	1035	53·95
G. A. Brown, Tredegar	1024	56·55
Forster Brown and Rees, Glyncorrwg...	717	75·33
W. T. Lewis (Sir, Bart.), Treherbert	670	70·50
E. J. Lowe, F.R.S., Shirenewton, Chepstow	530	39·46
W. T. Lewis (Sir, Bart.), Mardy, Aberdare	431	57·69

1895.	Feet Above Sea Level.	Inches.
Evan Jones, Aberdare	430	57·26
W. E. C. Curre, Itton Court, Mon.	370	37·47
T. Hutchins, Gwernyfed Park, Three Cocks, Brecon ...	350	32·46
F. J. Mitchell, Llanfrechfa	326	39·31
Daniel Owen, Ash Hall...	315	38·74
H. A. Lewis (Miss), Tan-yr-allt, Ystalyfera	300	52·27
Wm. Jones, Reservoir, Pontypridd	300	53·52
Henry Clay, Piercefield, Chepstow	300	36·62
H. M. Jackson (Sir, Bart.), Llantilio Court, Abergavenny ..	207	34·85
Edwin C. Pole, Neath	204	40·90
James Bell, C.E., Barry	191	32·36
Lord Llangattock, The Hendre, Mon...	176	29·19
Godfrey Clark, Talygarn, Glam.	150	45·28
C. H. Priestley, Lisvane	135	33·02
O. H. Jones, Fonmon Castle	130	39·64
C. H. Priestley, Cogan	121	32·48
Iltyd Nicholl, The Ham, Cowbridge	96	32·40
Franklen G. Evans, F.R.A.S., Llwynarthan	72	36·48
George Evans, The Rest, Porthcawl	60	31·07
C. H. Priestley, Ely	53	38·56
A. Pettigrew, Castle Gardens, Cardiff...	39	35·04
Togarmah Rees, C.E., Porton, Mon.	26	27·61

Taken generally, these returns show a deficiency of rain over the whole district, with one or two exceptions, for the entire year; but the totals do not indicate the excessive dryness of some periods, because the copious downpour at other times did much to make up the quantity. The distribution followed more or less the usual rule of increase in proportion to elevation above sea level and westerly position. This is not quite so evident in very dry years, because the heavy falls, especially in connection with thunderstorms, are often local in incidence, and bear an undue ratio to the annual totals. For example, the rainfall at the Castell Nos Reservoir of the Pontypridd Waterworks is usually much heavier than that of the Company's Pontypridd Reservoir, but last year the position was reversed, owing to partial rain storms. Another factor is the courses taken by cyclones, which vary very much, and also local peculiarities in the configuration of the land, both of which influence the result. The highest total was again that of Glyncorrwg, 75·33 inches. The second place was taken by Taff Fawr, 72·12 inches. The Treherbert gauge, which occupied the first place for some years, and has since maintained a good second, last year became third. This may be due to prophetic jealousy on the part of Jupiter Pluvius of the honour to be conferred on the observer by a rival and terrestrial potentate. The lowest record was that of a new aspirant for pluvial honours, viz., Porton, on the shore of the Severn Sea, some miles above Newport, only 27·61 inches. The next is the Hendre, Mon., with 29·19 inches, then the Rest, Porthcawl, 31·07 inches, and Barry, 32·36 inches. The Ham, the champion light weight of many years,

now takes the fifth place, with 32·40 inches. These are the chief items in the rainfall account of 1895, and they present an interesting display of some of the peculiarities of a most abnormal year. Our warmest thanks are due to the kind and scattered band of observers, whose united labours enable us to give a bird's eye view of the behaviour of the elements every year.

Ozone was satisfactorily developed, and reached a mean degree of 5·200.

Temperature in 1895 was made up of great extremes, but the resulting mean of its many variations was rather above the average. The maximum reading of the thermometer in the shade, 4 feet above ground, was 83 degrees on June 25th, and the lowest night record was 13 degrees on February 9th, giving a wide range of 70 degrees. The greatest daily range was 37 degrees on June 16th, the least variation *nil* on December 25th, and the mean daily range, 16·7 degrees. The mean of the maximum temperatures was 58·1 degrees, and of the minimum, 41·4 degrees. The mean heat of the year was 49·7 degrees, which is 0·7 degree above the Greenwich average of 50 years without correction.

The great Frost and Drought. A frost of extreme persistence and severity, and fully entitled to be called "great," commenced on December 30th, 1894. It went on with slight intermission all through January, 1895, gradually increasing in intensity. With gathering strength it continued much more severely throughout February into March, and did not finally break up until March 18th—a period of 79 days, out of which there was frost on 65 nights. During this time the day temperature, also, was unusally low, and on numerous occasions hard frost went on all day and night, which sank deep into the ground, and produced an iron-bound condition for many weeks. The frost was most severe in February, and the culminating point was reached on the 9th of that month. This exceptional amount of cold caused great discomfort and inconvenience, and a dislocation of water works services entirely without precedent. The pipes froze, and the expansion of the imprisoned ice rent them asunder with irresistible force, and rendered a constant supply in hundreds of towns most difficult. Destruction of pipes occurred on a scale of magnitude hitherto quite unknown, and the money value in the country generally must have reached a total of hundreds of thousands of pounds. It is a curious fact that the frost affected the pipes at a greater depth—even over four feet—than the cold penetrated into the solid earth, as ascertained by experimental thermometers sunk into the ground to take underground temperatures. This was a puzzling circumstance, but susceptible of reasonable explanation. The water in the pipes was not much above the freezing point when it entered them, and so carried a high degree of cold to the depth in which the pipes were buried—2 to 4 feet. Then stand pipes, hydrants, &c., being made of metal, therefore good conductors of cold, caused a further depression of temperature, and gave increased intensity to the frost that penetrated into the earth and caused the unprecedented

breakage of pipes. This seems to be the most probable view of the phenomenon, and it is the one favoured by Mr. J. G. Symons. Soil, too, may be an important factor. Gas pipes, also, suffered considerably, but this was due to fracture from the expansion and consequent upheaval of the soil. It is interesting to note that an anti-cyclone of great persistency held sway throughout February—in fact, from January 27th to March 5th inclusive. Many will ask how this frost compares with others in the present century. In my paper on the "Meteorology, &c., of 1890," I gave a comparison of the great frost of that year with the most remarkable of its predecessors, and I must refer enquirers to that volume of Transactions. Briefly stated, the frost of 1890-1 was very prolonged and intense, and lasted from November 25th to January 22nd, with slight intermissions; but the absolute minimum temperature was not so low as in some other winters. It probably ranked next to that of 1813-14, which was then still the most rigorous winter of this century. The late frost rather surpassed that of 1890-1 in persistence and steady lowness of temperature, and was unprecedented in the destruction of water and gas pipes. It was, however, less notable than the winter of 1813-14 in the amount of snow and interruption of locomotion and business; but at that time water and gas pipes were not much known. That great historical winter was more picturesque, with its fair on the Thames and other romantic incidents, but less subversive of home comfort, in which our modern requirements render us much more vulnerable. After March 18th, 1895, far milder conditions prevailed, and a fair quantity of rain fell that helped to soften the frozen ground. With April a warm period set in, with steadily increasing dryness, that culminated in a severe drought which lasted until the middle of July. This drought was of an extraordinary character. The scarcity of moisture began in February, which was extremely dry, in fact, wholly without rain in this district, with the exception of a slight fall in a few places on the last day. This had a bad effect on the springs, which usually increase in force with the copious rainfall common at this period. The old adage says: "February fill dyke, be it black or be it white," which shows that either rain or snow is expected to be prevalent at that season. March did not do much to replenish the water courses, and the subsequent heat and drought parched up the country in a remarkable degree, and led to great difficulties in maintaining the water supply in our towns and villages. The strain was much increased by the enormous destruction of pipes caused by the previous frost, which required months to completely repair. It is worthy of note that in the past nine years we have had three seasons of great heat and drought, viz., in 1887—Jubilee year—1893 and 1895. Taken altogether, the visitation of last year was the most severe, and, following as it did such an intense frost, it was indeed an *annus mirabilis*, a year of unique character. We have had severe frosts and parching droughts, but perhaps never before both in such singular combination. After a spell of broken weather, from the middle of July to the middle of August, fair conditions were again

in the ascendant, and reached their zenith in one of the loveliest Septembers ever known, with quiet anticyclonic weather, and a mean temperature 5 degrees above the average. The close of the month surpassed all the rest, and the heat was up to 80 degrees in the shade as late as the 24th, and records nearly equal to this were registered on many other days. This constituted a brief summer of surpassing warmth and beauty, and was an extreme instance of a late summer quite familiar in the weather-lore of our ancestors, and known by our Welch friends by the name of "Haf bach Gwyl Fihangel"; in English, "Michaelmas Summer," and in America, "The Indian Summer," when the declining glories of the warm season of the year seem to flash up again with renewed heat and energy for a short period, and delay the chill embrace of the coming winter. The weather remained mild and open until October 23rd, and roses, dahlias, and other flowers were in luxuriant bloom until that date. Pomegranates blossomed at Kew, rashberries were gathered on the 20th from the new canes, the abnormal heat, in fact, had the effect of disturbing the usual course of vegetation. Late autumn fruiting, however, cannot but be injurious to the next year's crop, as it is a premature development of the next season's yield. A horse chestnut near London put out a fresh crop of leaves and blossoms, and birds took to nesting again, quite oblivious of the time of year. A sudden change occurred on the night of the 23rd, and completely altered the face of the country, and a week of frost, unusually severe for the season, set in. After this the weather became mild, damp, and often stormy, and brought to a close a most remarkable year.

It is impossible to chronicle a tithe of the interesting results of such abnormal conditions of climate, a few must suffice. The frost caused great destruction of oysters at the Mumbles and other places, hundreds of thousands perished. In a deep valley in Scotland, 19 sheep were buried in snow drifts to a depth of 20 feet, and so remained for six weeks. Strange to say only two died. They appear to have passed into a state resembling hybernation, and when rescued were very sluggish and sleepy for a while. The snow would have kept them warm, and no doubt the functions of life slowed down to their lowest point, and so diminished oxidation and waste of tissue. On March 23rd a singular collapse of St. Catherine's Tunnel, near Guildford, on L. & S. Western line to Portsmouth, happened while a train was passing through. The cause was percolation of water from a main overhead, which had been broken by the frost. Dr. Wakefield's stables, coach-house, four carriages, two horses, harness, &c., disappeared. The engine and part of a train of empty carriages also were buried. An engineer of the company estimated the weight of earth that fell in at fully 1000 tons. Our cold winter was followed by a similar one in New Zealand, and caused much loss of cattle, &c. During last winter cones of ice were formed on the borders and surfaces of the Swiss lakes, especially that of Neuchâtel. Some of the cones, according to Prof. Dufour, were over six feet high, and had a crater-like hollow, from which a man

would have had difficulty in escaping without help. The same phenomenon was observed in the winter of 1788-9 on the Lake of Geneva. At the well-known summer resort of Argeles, near Pan, snow was reported in June, and the lake thinly coated with ice. The Devil's Bridge was damaged by severe frost and stress of weather. The middle was cracked, the south side has given way, and the whole structure was in great jeopardy. A wedding party in Cumberland were snowed up and remained in Church all night.

AGRICULTURE in 1895 experienced mixed conditions, giving rise to buoyancy and gloom, the latter, however, predominating. The low prices that have ruled so long still continued, and left but a small margin of possible profit, even if the other circumstances of the industry had been favourable, which was not the case. The weather in the first two months of the year was too severe even for the most ardent admirer of old fashioned winters. Frost is always welcome at the proper time and in moderate degree, but last year it was more intense than could be beneficial, and, in fact, it did a great deal of harm, and delayed too long necessary agricultural operations. The severe frost, unfortunately, was followed by heat and drought of much intensity, which prevented vegetation from recovering the complete check given to it by the prolonged cold. Grass and grain crops alike suffered. Hay made but little growth, and in some cases it was grazed not being worth cutting, and pastures were brown and bare. Wheat was light in ear and stunted in straw, and proved a most disappointing crop. This state of things lasted all through the growing period, and when the time of harvest arrived, the weather turned to cool and wet, and damaged the in gathering of what was at the best but a poor yield. This perversity has been a feature of our climate for several years past —the growing time, dry and parching; the harvest, wet and catching. Drought and heat and refreshing rain are admirable in their proper places, but do nothing but harm when ill-timed and badly distributed. Later on, the plenteous rains of the latter part of July and the first half of August had a marvellous effect on the meadows—hot and thirsty after the long drought—and produced an astonishing growth of thick succulent grass. In some cases this was cut as a second crop, and in all furnished a rich carpet of green pasture that stood the farmer and grazier in good stead for the rest of the year, and economised the scanty stores of dry food. This aftermath was one of the most abundant ever known, was the principal bright spot in the year's operations, and did much to mitigate the previous loss. The day of the corn crops was already over, and they could not derive much benefit. Green crops, also, suffered much from excessive dryness. It was most difficult to get the seeds to start at all for lack of moisture, and afterwards, growth was so slow that the plants fell an easy prey to insect pests. Potatoes did better than most other crops, and gave an abundant yield. This leads to low prices, but the farmer can utilise his surplus tubers to supplement deficiency in other foods. Happily for our agriculturists the price of wheat—long so low—has somewhat improved

—and it is to be hoped that, in some way or other, the decrease in the area under wheat may be arrested, and corn growing again take its former place in the rotation of crops. It is an alarming fact that we are dependent on other countries for four-fifths of our wheat, and the most elementary considerations of public safety and well-being are incompatible with such a dangerous state of things.

Health and Life in 1895. Public health and mortality varied much at different periods of the year, and were generally in harmony with the meteorological surroundings. Although January was cold, it was fairly fine and endurable, and the death rate did not rise much above the normal. Moreover, cold and heat do not show their effects immediately, and need time to demonstrate their influence. Further, they are cumulative, and pile up the results in an increasing ratio. In February the cold became far more intense, and an epidemic of influenza set in, and the mortality gradually rose to an average of 35 per 1000 in the whole group of 33 towns selected for sanitary investigation and comparison. In some of them the rate was 40 per 1000; at Halifax 43·4, at Oldham 44, Brighton and Plymouth 48, at Nottingham 49·2, and Liverpool the high rate of 55·5. Almost at the same time frost and influenza relaxed their deadly grip, and the mortality rapidly declined. In the beginning of the second quarter it was near the mean, and with the advent of fine and genial weather the death-rate became low. In the third quarter there was a slight rise from diseases incidental to hot weather, diarrhœa, &c. The fourth quarter the weather was moderate, and mortality nearly normal. The death-rate for the year was 26·6, compared with 18·1 in the more equable conditions of 1894. This represents an increase of over 26,000 deaths in the past twelve months. As usual, the Lancashire group of towns came out badly. Liverpool, Blackburn, Bolton, Burnley, Manchester, Oldham, Preston, and Salford, had an average for the whole year of 24·3; whereas five towns in Yorkshire—Bradford, Halifax, Huddersfield, Leeds, and Sheffield, whose population nearly equals that of the Lancashire towns, had a rate of only 19·4. The difference represents a loss of 6,500 lives in the Lancashire group. This is not a chance contrast, but persistent, and indicates better conditions of health, and perhaps local differences of climate in the Yorkshire district. The effect of cold and heat on health and life is very marked, but the incidence varies somewhat. Cold weather increases the mortality in old people, and heat amongst the very young, from diarrhœa, &c. This must not be taken too absolutely, as extreme cold and heat always severely try the extremes of life. The direct action of cold is often fatal by people being frozen to death. Heat is equally dangerous, and many cases of sunstroke occurred, especially during the unprecedented heat-wave that passed over the country at the end of September.

Thunderstorms and Earthquakes were very numerous and fatal in different parts of the world, but limited space will not permit a detailed account of them. The loss of life from these causes is really

considerable, and gives one the impression that there is an increasing mortality from these destructive agents. This, probably, is not the case, but results from the greater publicity given to all accidents through the press now than formerly.

The Observatory on Ben Nevis was the scene of a singular thunderstorm on June 19th, in the course of which a flash of lightning entered the building, fused the telegraphic wires, and damaged the instruments. The lining of the Observatory consists of wood and dry felt, which were set on fire; but, fortunately, the observers, assisted by a couple of visitors, extinguished the flames before much damage was done. The force of the flash knocked objects off the shelves, and pictures were hurled across the room. One observer was stunned by the shock, but soon recovered. The lightning made itself felt, also, at the hotel on the summit, and the corrugated-iron roofing was struck and displaced. When the storm burst over the mountain, snow was falling heavily, and temperature down to freezing point. Telegraphic communication was interrupted, and details of the event were conveyed to Fort William by the two visitors. The general staff of the Observatory were engaged at a distance, and so escaped the risk.

Astronomy possesses a never-failing interest to many minds, and the past year has left something to record, although nothing very startling occurred to disturb the serenity of the midnight sky.

Occultations. The moon in her monthly passages through the heavens obscures many and various stars and planets within the limits of deviation assigned to her by the Great Engineer of the Universe and these vary from year to year. In 1895 occultations were numerous and interesting. Regulus, in Leo, a star of almost the first magnitude, was obscured on June 26th and on several other occasions. The Pleiades, on October 7th and other dates. Venus was occulted on July 25th, and should have furnished a pleasing spectacle, but unfortunately she was below the horizon before the event took place. Many small stars were obscured by the eclipsed moon on the morning of March 11th, and on such occasions the phenomenon is additionally attractive.

Mercury was visible in the western sky in the early part of February, and again later in the year. The transit of this planet across the sun near the end of 1894 was scarcely seen in this country, owing to the event happening just before sunset, and here clouds, also, interfered. It was well observed in the southern hemisphere, and the black drop noticed in transits of Venus was seen in that of Mercury under circumstances that confirm the idea that the appearance is entirely due to our own atmosphere. The white spot said to have been observed on the dark body of Mercury at times of transit was carefully looked for, but without success.

Mars was not very interesting in 1895. The dark colour of the planet below the snow cap, as it recedes in the martial summer, is believed by some to be vegetation springing up when the snow has left, and the red body of Mars is possibly desert.

JUPITER was narrowly scanned in the past year, but the broad face of the giant did not reveal any new features. The fifth satellite, discovered on September 9th, 1892, by Prof. E. E. Bernard, through the great 36-inch Lick telescope, in California, remains to a great extent the property of the discoverer. This is a most difficult object, and far beyond the reach of any ordinary telescope, even of good size. The reason is obvious, the diameter of the satellite is only about 100 miles, and its distance from its primary only half that of the moon from our own earth. Then the light of Jupiter is intensely bright, and the velocity of his tiny moon very great, as it revolves round the primary.

SATURN is now becoming once more a grand object. The rings are opening out, and his aspect is constantly improving. Some time ago amateur astronomers in this country fancied they saw a white spot on the great ring, but Professor Bernard says he cannot see through the Lick telescope the object said to have been observed in some small instruments. It must have been the result of imperfection in the telescopes employed. There has been a growing opinion amongst astronomers, for some years past, that the rings of Saturn are composed of numberless meteors, which revolve round the planet at different rates of speed according to their distance from the primary. This is in harmony with the rule that governs the planets, and it is the only theory, which on mathematical and other grounds seems to be quite satisfactory. Professor James E. Keeler, of the Alegheny Observatory, has recently taken spectroscopic observations that tend strongly to confirm this view of the meteoric constitution of the rings. This is another instance of the valuable assistance of the spectroscope as a handmaid of astronomical science.

SUNSPOTS are now beginning to decline. The maximum period was reached about August 1893. The northern hemisphere showed a waning tendency earlier than this, but it was made up for by increased activity in the south. A general diminution is now evident.

ECLIPSES. The only eclipse of any general interest in 1895 was that of the moon on March 11th. It was well observed in this neighbourhood, as the night was beautifully fine and bright, though the time was not very convenient. It commenced at 1.55 a.m., was total at 3.40, and ended at 5.25. The general colour of the eclipse was deep copper, but darker in the centre than near the edge. This however was not quite uniform, for in places the tint inclined to bluish gray. The colour of lunar eclipses varies very much—from a blackness that renders the disc wholly invisible to a light copper hue, and it is a matter of much interest to note the variation in colour of different eclipses. The eclipse of October 4th, 1884, was very dark, but the moon could be distinguished through an opera glass. Some on record have been quite invisible. That of July 12th, 1870, was a bright coppery red, and the moon looked like a blood-stained orb suspended in the evening sky, and was associated in the minds of superstitious people with the Franco-German war that was then impending. The late eclipse was intermediate between these extremes. The cause of the

difference of colour is no doubt to be found mainly in our own atmosphere, and it is most probably due to the varying amount of watery vapour suspended in the air, which exerts double the usual effect during an eclipse, the red glow of the setting sun is due to this cause, but it must be remembered that the rays then pass through only half our atmosphere, whereas in an eclipse they traverse the whole length on their way from the sun to the moon, and so the effect is greatly increased.

Celestial Photography continues to be applied with great success and increased precision, in advancing the science of astronomy. Some of the most interesting results of its application have been the discovery of new nebulœ, and in some cases the effort has been successful only after prolonged exposure, and the use of extremely sensitive plates. It was found by Bennett that bromide of silver plates, treated with gelatine and long warming at a moderate heat, became thirty times as sensitive as plates not so treated, and yet the exposure necessary, was sometimes as much as four hours. Thus new worlds and the cosmical materials out of which worlds are made, are being constantly revealed; and such discoveries go far to confirm the nebular hypothesis which steadily increases its hold on scientific belief, as the only theory that explains all the phenomena of creation. On this view all created matter was once in a state of nebula and filled the bounds of space. The laws of heat show how all the stars—burning suns as they are believed to be—as well as the solar system, could be slowly evolved out of the nebulous material; and how their glowing active life by the same laws—as we understand them—must be finite and come to an end. The present existence of such a vast amount of nebulous matter shows that the process is still going on, and new worlds of equal grandeur and brilliancy are being gradually formed to continue the mighty round of sun and planet creation. When we look back and contemplate the beginnings of life on this small globe, and the groping blind condition of its first tiny inhabitants in deep primeval seas, and the gradual rise in the scale of created things, until man, the crowning work of all, appeared, we are filled with awe and wonder at the gigantic march of creation, and the perfection attained. This same man is now permitted to scan the heavens, sound the star depths, and by an intelligence, almost divine, to penetrate their secrets. It is also his great privilege to lay the results of his researches humbly, lowly, and reverently at the footstool of the Almighty Architect of the Universe.

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD.

No. of Gauge on Map..... / Rain Gauge { Diameter of Funnel..... / Height on Top { Above Ground... / Above Sea Level (As levelled from Ordnance B.M.)	C. H. Priestly, Taff Fawr, No. 1 Reservoir, Brecon. 5 inches. 1 foot. 1,328 feet.				G. A. Lundie, Cwm Bargoed, Glamorgan. 5 inches. 1 foot. 1,237 feet approximately.				W. Jones, Castell Nos Reservoir, Mardy, Rhondda, Glamorgan. 5 inches. 1 foot. 1,110 feet.			
1895.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	6·88	0·93	20th	22	3·08	1·52	19 & 20	9	5·42	1·88	21st	15
February	0·28	0·09	28th	6	...	...	.....	...	0·25	0·19	25th	2
March	7·71	2·10	23rd	23	4·38	1·39	6th	7	3·93	1·10	24th	15
April	5·25	1·44	22nd	17	3·05	0·60	20th	12	2·80	1·06	23rd	13
May	2·40	0·92	25th	8	0·75	0·28	23rd	3	0·88	0·62	26th	4
June	2·53	1·26	30th	10	0·96	0·40	11th	5	0·88	0·37	29th	5
July	9·37	1·24	24th	19	5·68	1·46	1st	13	4·00	1·03	25th	6
August	9.79	2·61	26th	22	5·05	0·87	12 & 26	12	8·11	1·07	12th	21
September	2·44	0·95	10th	9	1·43	0·82	10th	5	2·56	1·41	10th	6
October	5·06	0·97	12th	18	4·45	0·90	4th	10	4·27	1·01	5th	11
November	12.48	2·80	10th	23	9·04	3.81	10ht	18	8·99	1·03	15th	21
December	7·93	1·22	15th	26	4.39	0·88	14th	13	6·48	0·97	5th	21
Total	72·12			203	42·26			107	48·57			140

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	Geo. Palmer, Penwyllt, Brecon.	R. C. Harrison, "Gwernllwyn," Dowlais, Glamorgan.	Geo. Arthur Brown, Tredegar, Monmouthshire.
Rain Gauge: Diameter of Funnel.....	5 inches.	5 inches.	8 inches.
Rain Gauge: Height above Ground...	1 foot.	1 foot 9 inches.	1 feet.
Rain Gauge: on Top above Sea Level (As levelled from Ordnance B.M.)	1,108 feet.	1,035 feet.	1,024 feet.

1895.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January ...	4·85	1·28	19th	11	6·40	1·00	12th	21	7·06	0·94	12th	17
February	0·90	0·62	24th	2	0·10	0·05	24th	3	0·18	0·14	24th	2
March ...	7·68	2·53	23rd	13	5·27	1·63	23rd	18	5·86	1·77	23rd	18
April ...	3·80	1·13	22nd	11	3·30	1·17	22nd	12	4.22	1·44	22nd	11
May ..	1·34	0·72	24th	4	1·23	0·48	25th	5	0·61	0·34	31st	3
June ...	1·20	0·39	28th	7	1·32	0·49	11th	7	1·01	0·30	30th	6
July ...	8·32	1·24	1st	16	6·95	1·80	1st	16	7·27	1·12	1st	15
August ...	9·11	2·09	26th	18	5·55	0·83	12th	19	5·87	0·85	26th	19
September	2·00	0·98	11th	5	1·96	1·07	10th	9	2·13	0·92	10th	9
October...	4·40	0·61	1st	10	4·20	0·70	5th	16	3·66	0·66	21st	14
November	10.35	1·83	11th	20	11·56	3·18	10th	23	11·75	2·88	10th	22
December	7·21	0·97	4th	17	6·11	1·13	5th	27	6·93	1·00	5th	26
Total ...	61·16			134	53·95			176	56·55			162

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	FORSTER BROWN & REES, Glyncorrwg, Glamorgan.	SIR W. THOMAS LEWIS, BART., Treherbert, Glamorgan.	E. J. LOWE, F.R.S. Shirenewton Hall, Monmouthshire,
Rain Gauge: Diameter of Funnel.....	5 inches.	5 inches.	8 inches.
Rain Gauge: Height on Top: Above Ground...	4 feet 6 inches.	1 foot.	1 foot.
Rain Gauge: Height on Top: Above Sea Level (As levelled from Ordnance B.M.)	717 feet.	670 feet.	531 feet.

1895.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which '01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which '01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which '01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	7·41	1·43	21st	21	8·84	2·24*	21st	15	5·456	0·970	19th	22
February	0·15	0·10	25th	4	0·52	0·35	1st	3	0·062	0·047	24th	1
March	9·65	2·05	24th	21	6·32	1.56	22nd	13	3·923	0·852	24th	17
April	6·07	2·38	23rd	18	5·14	1·52	22nd	15	3·194	0·668	24th	17
May	0·50	0·23	25th	3	0·44	0·35	24th	2	0·347	0·163	1st	3
June	1·46	0·35	30th	9	0·37	0.37	30th	1	2·222	0·771	30th	8
July	11·70	1·74	2nd	19	8·10	1·72	1st	15	4·328	0·795	23rd	15
August	10·18	2·38	27th	20	12·10	1·95	27th	22	5·569	0·835	12th	20
September	2·99	1·25	11th	10	1·58	1·04	10th	3	1·229	0·412	6th	10
October	5·41	0·85	6th	18	5·50	1·25	5th	16	3·833	1·100	5th	17
November	11·11	1·57	16th	24	13·48	2·18	10th	23	5·787	0·715	10th	23
December	8·70	1·10	16th	28	8·11	1·21	15th	25	3·513	0·540	12th	24
Total	75·33			195	70·50	15·74		153	39·463			177

* Snow.

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....												
Rain Gauge: Diameter of Funnel.....				5 inches.			5 inches.			8 inches.		
Rain Gauge: Height on Top: Above Ground...				2 feet.			4 feet 6 inches.			4 feet.		
Rain Gauge: Height on Top: Above Sea Level (As levelled from Ordnance B.M.)				431 feet.			425 feet.			390 feet.		
1895.				Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
				Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January ...	..	...	...	6·72	0·98	20th	20	8·38	1·22	14th	20	4·105	0·920	20th	11
February	...	...	...	0·06	0·06	28th	1	0·47	0·46	1st	2	0·020	0·020	24th	1
March ...	...	...	...	6·98	1·20	27th	16	6·83	2·30	24th	14	3·890	0·900	26th	11
April ...	...	...	..	3·85	1·46	22nd	14	2·18	0·46	21st	13	3·190	0·720	25th	13
May ...	...	...	...	0·87	0·32	25th	4	0·66	0·40	25th	4	0·260	0·160	1st	2
June ...	...	...	...	1·20	0·32	28th	5	0·73	0·29	29th	3	2·200	0·860	30th	8
July ...	...	...	...	6·45	0·92	1st	16	6·70	1·27	21st	14	3·970	0·660	23rd	12
August ...	...	...	...	7·25	1·23	12th	19	6·98	1·50	10th	13	5·210	0·690	23rd	18
September	...	...	..	2·12	1·22	10th	8	1·75	1·20	11th	6	1·050	0·390	6th	7
October...	...	...	...	4·34	0·93	5th	15	4·17	0·86	5th	9	4·990	1·250	5th	12
November	...	...	..	11·33	1·77	15th	21	11·96	2·30	11th	23	5·620	0·820	5th	21
December	...	...	...	6·52	1·16	12th	25	6·45	0·94	6th	15	2·960	0·630	12th	17
Total ...	...	...	...	57·69	11·57		164	57·26	13·20		136	37·465			133

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	T. Hutchins (Gardener), Gwernyfed Park, Breconshire.				F. J. Mitchell, Llanfrechfa Grange, Monmouthshire.				Daniel Owen, Ash Hall, near Cowbridge, Glamorgan.			
Rain Gauge { Diameter of Funnel.....	5 inches.				5 inches.				8 inches.			
Rain Gauge { Height { Above Ground ...	1 foot.				4 feet.				1 foot.			
Rain Gauge { Height on Top { Above Sea Level (As levelled from Ordnance B. M).	350 feet.				326 feet.				315 feet.			
1895.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which '01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which '01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which .01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	5·33	1·09	20th	23	5·25	1·11	20th	17	4·19	0·75	19th	20
February	0·05	0·03	1st	3	0·05	0·04	28th	2	0·12	0·28	7th	2
March	1·95	0·30	23rd	20	4·20	1·50	23rd	14	4·05	0·83	27th	18
April	1·84	0·60	25th	16	3·00	0·88	22nd	14	2·38	0·57	20th	15
May	0·57	0·21	1st	6	0·34	0·27	31st	3	0·43	0·25	31st	3
June	0·96	0·60	30th	8	1·49	0·65	30th	7	1·08	0·45	30th	7
July	3·62	0·83	1st	15	4·17	0·83	23rd	15	4·54	1·05	1st	15
August	3·04	0·99	12th	20	4·34	0·72	10th	17	4·57	0·86	12th	16
September	1·01	0·43	10th	9	1·53	0·445	6th	9	1·71	0·63	6th	8
October	4·12	0·80	21st	19	3·70	0·81	5th	11	5·09	0·111	30th	12
November	5·51	1·17	10th	25	6·76	1·23	5th	22	5·49	0·78	10th	25
December	4·46	0·50	11 & 24	28	4·48	0·67	12th	21	5·09	0·75	14th	25
Total	32·46			192	39·31			152	38·74			166

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	Miss H. A. Lewis, Tan-yr-allt, Ystalyfera, Glamorgan. 8 inches. 1 foot 6 inches. 300 feet.				W. Jones, The Reservoir, Pontypridd, Glamorgan. 5 inches. 1 foot. 300 feet.				Henry Clay, Piercefield Park, Chepstow, Monmouthshire. 5 inches. 1 foot 6 inches. 300 feet.			
Rain Gauge { Diameter of Funnel.. ..... Height { Above Ground.. on Top { Above Sea Level (As levelled from Ordnance B.M.)												
1895.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	6·49	1·14	21st	19	5·75	1·35	13th	10	4·73	0·95	20th	17
February	0·13	0·10	25th	2	...	...	...	...	0·08	0·05	24th	2
March	3·61	0·88	28th	20	4·89	1·95	24th	8	3·61	0·72	27th	15
April	3·10	0·88	23rd	14	4·12	1·22	22nd	12	3·05	0·88	24th	16
May	0·12	0·10	25th	2	0·18	0·18	31st	1	0·60	0·25	31st	3
June	0·71	0·16	1st	9	1·42	0·62	30th	4	2·30	1·32	30th	8
July	8·14	0·88	2nd	18	7·93	1·09	23rd	15	3·73	0·65	23rd	15
August	7·97	1·77	27th	21	6·21	1·20	26th	18	5·43	1·05	12th	20
September	2·16	1·06	6th	8	2·02	0·70	10th	4	0·94	0·42	6th	6
October	4·29	0·98	6th	17	4·90	1·25	5th	11	4·31	1·12	5th	13
November	9·42	1·63	11th	22	8·60	1·67	10th	22	5·23	0·81	10th	20
December	6·13	1·05	13th	23	6·50	1·13	15th	17	2·61	0·48	12th	19
Total	52·27			175	52·52			122	36·62			154

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map	Sir H. M. Jackson, Bart., Llantilio Court, Abergavenny, Monmouthshire.				Edwin C. Pole, Neath, Glamorgan.				Thos. Coomber, pro. Lord Llangattock, The Hendre, Monmouthshire.			
Rain Gauge { Diameter of Funnel.....	5 inches.				5 inches.				8 inches.			
Rain Gauge { Height { Above Ground....	10 inches.				1 foot.				1 foot.			
Rain Gauge { on Top { Above Sea Level	207 feet.				204 feet.				176 feet.			
(As levelled from Ordnance B.M.)												
1895.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	5·82	1·00	20th	13	5·39	1·05	20th	20	4·90	0·78	20th	21
February	...	...	...	...	0·09	0·05	24th	3	0·08	0·03	24 & 28	4
March	3·34	0·55	26th	13	4·03	0·90	23rd	18	2·25	0·46	23rd	18
April	2·60	0·52	26th	8	2·74	1·03	22nd	15	2·20	0·60	22nd	16
May	0·67	0·30	1st	4	0·36	0·16	1st	3	0·43	0·29	1st	4
June	1·17	0·50	30th	6	0·62	0·22	30th	6	1·19	0·66	30th	7
July	2·84	0·58	1st	14	6·06	1·55	1st	17	2·31	0·50	1st	13
August	3·17	0·50	10th	16	5·26	1·11	12th	20	2·47	0·46	13th	18
September	1·16	0·50	6th	6	1·73	0·68	10th	7	1·23	0·45	6th	9
October	3·24	0·60	21st	13	4·07	0·78	21st	17	3·20	0·62	21st	18
November	7·28	1·83	10th	21	6·83	0·95	5th	21	6·15	1·21	10th	22
December	3·56	0·53	12th	19	3·72	0·63	14th	26	2·78	0·48	12th	23
Total	34·85			133	40·90			173	29·19			173

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	Godfrey L. Clark, Talygarn, Llantrisant, Glamorgan.				C. H. Priestly, Lisvane Reservoir, Glamorgan.				O. H. Jones, Fonmon Castle, Glamorgan.			
Rain Gauge { Diameter of Funnel.....	5 inches.				5 inches.				8 inches.			
Rain Gauge { Height on Top { Above Ground..	2 foot 6 inches.				1 foot.				1 foot 2 inches.			
Rain Gauge { Height on Top { Above Sea Level (As levelled from Ordnance B. M.)	150 feet.				150 feet.				130 feet.			
1895.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	4·76	0·88	20th	16	4·07	0·62	20th	19	4·04	0·62	20	18
February	0·09	0·05	25th	2	0·15	0·07	24th	3	0·39	0·18	25	3
March	5·82	1·32	24th	16	3·59	0·86	23rd	17	4·77	0·90	28	19
April	2·62	0·66	21st	13	2·39	0·57	22nd	12	2·29	0·53	25	11
May	0·13	0·09	2nd	2	0·46	0·41	31st	2	0·21	0·17	2	2
June	1·18	0·38	1st	7	1·26	0·43	28th	7	1·53	0·32	14	9
July	6·13	1·46	2nd	18	3·94	0·75	23rd	15	4·92	0·72	24	16
August	3·82	0·81	13th	17	3·51	0·83	12th	19	4·75	1·27	13	16
September	1·44	0·65	7th	7	1·26	0·49	6th	8	0·95	0·54	7	4
October...	5·37	1·12	31st	15	4·00	0·85	3rd	12	5·89	1·19	6	15
November	7·07	1·39	11th	22	4·47	0·61	5th	22	4·23	0·51	11	20
December	6·85	0·92	15th	21	3·92	0·44	5th	24	5·67	1·14	18	22
Total	45·28			156	33·02			160	39·64			155

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	C. H. Priestly, Cogan Pumping Station, Glamorgan. 5 inches. 1 foot. 121 feet.				Iltyd Nicholl, The Ham, Cowbridge, Glamorgan. 9 inches. 1 foot 3 inches. 96 feet.				Franklen G. Evans, F.R.A.S., F.R. Met. Soc., &c. Llwynarthan, Castleton, Monmouthshire. 5 inches. 1 foot 1 inch. 72 feet.			
Rain Gauge { Diameter of Funnel..... Height { Above Ground... on Top { Above Sea Level (As levelled from Ordnance B.M.)												
1895.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	3·56	0·65	19th	17	3·88	0·52	20th	19	4·04	0·69	19th	19
February	0·07	0·06	24th	2	0·10	0·08	24th	2	0·11	0·11	28th	1
March	3·53	0·75	27th	14	3·38	0·75	26th	18	3·99	1·06	23rd	15
April	1·95	0·58	24th	13	1·74	0·41	17th	12	2·87	0·74	17th	14
May	0·46	0·36	31st	2	0·08	0·08	1st	1	0·33	0·27	31st	2
June	0·78	0·20	30th	8	1·26	0·25	13th	8	0·88	0·53	30th	5
July	4·95	0·75	19 & 23	15	4·56	0·77	24th	15	4·03	0·83	23rd	15
August	3·71	1·03	12th	15	3·94	0·74	12th	15	4·91	1·21	12th	21
September	1·45	0·34	6th	8	1·12	0·50	6th	7	1·69	0·54	30th	8
October...	4·06	1·00	5th	13	5·21	1·06	5th	15	4·41	0·95	5th	14
November	3·79	1·55	7th	21	3·07	0·43	5th	20	5·10	0·95	5th	22
December	4·17	0·61	15th	26	4·06	0·61	15th	21	4·12	0·58	5th	25
Total	32·48			154	32·40			153	36·48	8·46		161

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	G. Evans, The Rest, Porthcawl, Glamorgan. 5 inches. 1 foot. 60 feet.				C. H. Priestley, Ely Pumping Station, Glamorgan. 8 inches. 1 foot. 53 feet.				A. Pettigrew, Castle Gardens, Cardiff, Glamorgan. 1 foot 5 inches. 38·36 feet.			
Rain Gauge { Diameter of Funnel..... Height { Above Ground.... on Top { Above Sea Level (As levelled from Ordnance B.M.)												
1895.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	3·05	0·60	17th	17	4·84	0·68	19 & 20	19	4·00	0·70	19th	21
February	0·13	0·10	24th	2	0·19	0·09	28th	4	0·21	0·10	28th	4
March	3·65	0·76	26th	13	4·65	1·01	27th	17	3.84	0·83	27th	17
April	1·94	0·45	24th	12	2·32	0·42	22nd	14	1·79	0·58	24th	11
May	0·20	0·14	31st	2	0·48	0·39	31st	2	0·53	0·43	31st	3
June	1·44	0·63	30th	7	1·24	0·31	30th	8	1·47	0·84	30th	8
July	3·86	1·17	1st	11	4·76	0·74	23rd	16	4·62	0·87	23rd	14
August	3·31	0·37	5th	13	4·38	1·14	12th	18	3·93	1·21	12th	17
September	1·34	0·43	6th	7	1·29	0·49	6th	9	1·22	0·38	6th	8
October...	4·17	0·79	5th	13	4·70	1·13	5th	17	4·57	1·19	5th	16
November	4·35	0·62	10th	21	5·14	1·01	5th	21	4·82	0·75	5th	22
December	3·63	0·56	14th	22	4·57	0·67	15th	25	4·04	0·58	15th	22
Total	31·07			140	38·56			170	35·04			163

On several Fossils, including a "Spider" (Eophrynus) from the 9ft. Coal Seam at Ty'nybedw, Rhondda Valley.

By W. O'CONNOR
(Corresponding Member).

Read before the Biological and Geological Section on February 21st, 1895.

THE fossils of the South Wales coalfield have not been investigated to the same extent as those of some other coalfields. The writings of Mr. Wm. Adams, one of the founders of your society; the observations of Sir Wm. Logan on the stigmaria in the underclays; those of Mr. J. W. Salter on the fossils of the iron ores; some notes by Dr. Stur on a small collection from Llanelly; an able paper by Mr. Robert Kidston on the fossil flora of the coalfield; with a number of smaller papers scattered throughout the proceedings of various societies, constitute the whole of the publications treating of this subject known to the writer. There is also a list of fossils in Mr. Thomas Forster Brown's paper on the coalfield.

As the members of this section are all doubtless aware, the Carboniferous rocks are usually divided as follows, commencing with the lowermost:—1. Lower Limestone Shales. 2. Carboniferous or Mountain Limestone. 3. Upper Limestone Shale. 4. Millstone Grit. 5. Coal Measures. The first, second, and third being usually taken together, we have three broad divisions of strata.

The Coal Measures proper are usually divided into three series. The Lower Coal Measures, the Middle Coal Measures, and the Upper Coal Measures.

In the thickest part of the South Wales coalfield the Coal Measures are probably about 10,500 feet thick, and are locally divided into three series. The Upper Pennant series about 2,500 feet thick; the Middle Pennant series about 5,000 feet thick; and the White Ash series about

3,000 feet thick. The strata rapidly thins in coming eastward, until in the valleys converging on Cardiff the thickness of the uneroded part of the Upper Pennant would not exceed 600 to 700 feet; that of the Lower Pennant would be about 1,700 feet; and that of the White Ash series about 800 feet. This thinning out is continued eastward, and the various strata are much thinner at the eastern outcrop. By means of a most interesting outlier some miles from the edge of the coalfield in a north-easterly direction, a similar thinning out can be traced in the millstone grit and carboniferous limestone. A great many interesting problems occur in connection with this phenomenon, but time will not permit of our dealing with it further.

Recurring to the three-fold division of the strata of this coalfield, it would at first sight seem to correspond with the Upper, Middle, and Lower coal measures of the rest of Britain. It would appear, however, from recent researches, that this is not the case. In a paper on the fossils of the Kilmarnock coalfield, Mr. Kidston takes, as a typical area of the Upper Coal Measures of Britain, the Radstock series of the Bristol coalfield. The South Staffordshire coalfield he selects as a typical area of the Middle Coal Measures, whilst the type of the Lower Coal Measures would be found in a part of the Northumberland coalfield. Each of these divisions have a fossil flora presenting well marked characteristics, and the whole of the Carboniferous strata in Great Britain can be correlated throughout—though, of course, it is seldom that the whole of the divisions occur in one spot in their full development—and in his paper on the fossil flora of the South Wales coalfield he has worked out from the fossil plants the fact that our Upper Pennant series correlates with the Radstock and Farringdon series of the Bristol coalfield, and belong to the lower part of the Upper Coal Measures. The Lower Pennant series contains a mixture of Upper and Middle Coal Measure forms, and must, therefore, be regarded as a Transition series. The White Ash series contains (with the exception of two forms not hitherto found in Britain) Middle Coal Measure forms only. The Lower Coal Measures appear to be absent, as far as is known; though a suspicion has crossed the writer's mind that they are possibly represented in a debased form, by the marine shales, ironstones, &c., occurring near the Garw Vein at the bottom of the White Ash series. On this point there is, as yet, no evidence.

The following is a list of the plants collected by the writer:—

Calamitina varians; Calamitina approximata; Calamitina undulata; Calamites ramosus; Calamites Suckowii; Calamites Cistii; Calamocladus charæformis; Calamocladus equisetiformis; Annularia ? sp.; Sphenopteris obtusiloba; Sphenopteris trifoliata; Sphenopteris (? Renaultia) neuropteroides; Sphenopteris chœrophylloides; Neuropteris heterophylla; Neuropteris rarinervis; Neuropteris tenuifolia; Neuropteris gigantea; Neuropteris Osmundæ; Mariopteris muricata; Pecopteris Miltoni; Alethopteris lonchitica; Alethopteris decurrens; Alethopteris Davreuxi; Sphenophyllum cuneifolium; Sphenophyllum saxifragefolium; Sphenophyllum myriophyllum;

Lepidodendron ophiurus ; Lepidodendron aculeatum ; Lepidostrobus lanceolatus ; Lepidophyllum triangulare ; Bothrodendron punctatum ; Sigillaria camptotænia ; Sigillaria mammillaris ; Sigillaria scutellata ; Sigillaria polyploca ; Sigillaria elongata ; Sigillaria tessellata ; Sigillaria alternans ; Sigillaria catenulata ; Stigmaria ficoides ; Stigmaria ficoides *var.* minor ; Stigmaria Evani ; Cordaites angulosostriatus ; Trigonocarpus ; Pinnularia capillacea ; Asterotheca.

Of the fossil Fauna the writer has a number of mollusca of the Anthracosia type ; one Goniatites from the Pennant grit ; and, what is perhaps the most interesting of all, a portion of a "spider" *(Eophrynus)*, from the 9 feet seam at Ty'nybedw Colliery.

Note on Eophrynus.

By F. T. HOWARD and T. H. THOMAS.

THE specimen discovered by Mr. O'Connor in the roof of the Nine-Feet Seam (White Ash, or Ironstone Series), Ty'nybedw Pit, Pentre, in the Rhondda Valley, is an Eophrynus—an ancient type of the Arachnid family, which includes all the living species of scorpions and spiders.

The scorpion, as we know it, is very unlike the spider of to-day, but it is usual to find the characteristics of both in a single individual among the Arachnida of Coal-Measure times.

Mr. O'Connor's specimen is, unfortunately, not complete. The abdomen is well seen, but the anterior portion of the body and the appendages are altogether absent.

The figure shows the underside of the abdomen and the cast thereof enlarged to six times the natural size.

The abdomen is roughly circular in outline, and there are eight very distinct division lines between the segments. Those on the anterior part run fairly straight from margin to margin. The 5th and 6th bend regularly backwards and the last pair are sharply curved round the efferent orifice (*a*).

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A. Eophrynus carbonis, x6. B. cast of same.
C. Eophrynus Prestvicii abdominal surface (after Woodward), x 6/5.

T.H.T & M.P.P. del. ad nat.
M.P. Parker lith.

West, Newman imp.

There is a triangular somewhat slanting depression (*b*) on the 6th and another on the 7th segment, situated in the median line, the object of which is not clear.

The stigmata or openings of the tracheæ—the breathing organs—can be distinctly seen on the 2—6 segments (*c*), long oval in outline, and are situated on the front margin of the segments.

A curious depressed ridge (*d*) starts on either side on the 7th division line, runs directly forward to the 3rd and then bends outwards, giving the specimen a trilobated appearance.

A depression (*e*) follows the outline and roughly divides the marginal from the main portion.

An intermediate line of depression (*f*) is probably not characteristic of the species, but is due to pressure.

The margin terminates in 8 spines (*g*) on either side, which is connected by a pustulated portion with a scalloped edge.

The pustules are very small and are most numerous along the margin. A few occur on the main portion, especially along the edges of the segments.

The genus Eophrynus was created by Dr. H. Woodward, of the British Museum (to whom we owe many thanks for his kind assistance), from a perfect specimen discovered in the Coal Measures of South Staffordshire. The species was called *Eophrynus Prestvicii*. Another specimen from the same district had been figured previously by Buckland in his Bridgwater Treatise under another name —*Curculioides*—from its supposed relationship to the modern Diamond beetle.

Another species from the coal measures of Ostrau in Moravia, was named *E. Salmi* by Stur, and since that time the genus has been recorded from the United States.

In 1878 Dr. Woodward described what were presumed to be the remains of a fossil crab from the Mons coalfield, Belgium, which he named "Brachypyge carbonis." The specimen has recently been removed from the Crustacea into the Arachnid family, and has been called "Eophrynus carbonis."*

The specimen from Pentre is very similar to that from Mons, and, we believe, belongs to the same species.

Bibliography.

Buckland—Bridgwater Treatise, plate 46, fig. 2. *Curculioides Prestvicii* from Pennystone Ironstone.

H. Woodward—Geological Magazine, vol. VIII., 1871, page 385. On a new and very perfect Arachnide from the ironstone of the Dudley coalfield, with figure (*Eophrynus Prestvicii*), also from Coalbrookdale.

* See Geol. Mag., 1887, p. 49. Footnote: "Mr. S. H. Scudder, of Boston, suggests that it is probably the abdomen of an Arachnide nearly related to Eophrynus."
See also Presidental Address. Geol. Soc., 1896, p. CIX., Q.J.G.S., vol. LII.

STUR—Abhandlungen, d.k.k. geol: Reichsanstalt, vol. VIII., 1877, p. v., with figure. *Eophrynus Salmi.*

H. WOODWARD—Geol. Magazine, N.S., Dec. 2nd, vol. 5. Oct., 1878, page 433. Discovery of the remains of a fossil crab (Decapoda—Brachyura) in the coal measures of the environs of Mons, Belgium, with figure—*Brachypyge carbonis.* Also in Bull. Acad. Roy. de Sci. de Belgique, Ser 2, vol. 45, 1878, page 410.

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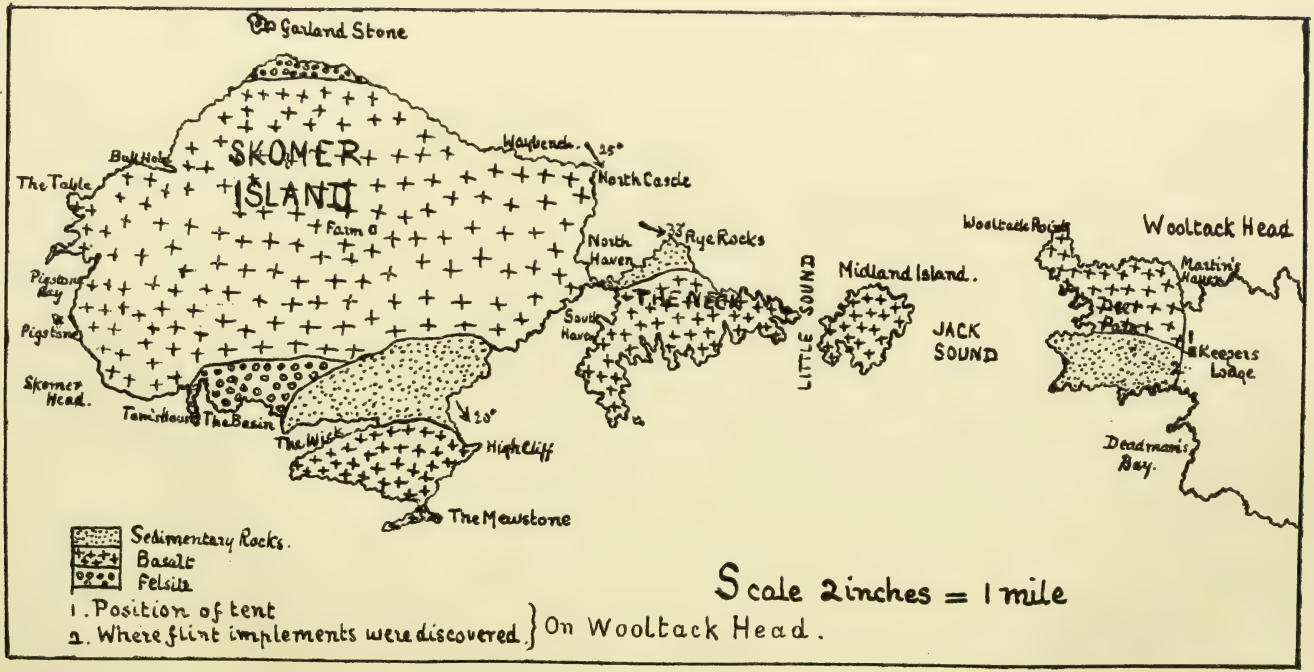

Garland Stone
SKOMER ISLAND
Bull Hole
The Table
Farm
Warbench
25°
North Castle
North Haven
23° Rye Rocks
THE NECK
South Haven
LITTLE SOUND
Midland Island.
JACK SOUND
Wooltack Point
Wooltack Head
Martin's Haven
Deer Park
Keepers Lodge
Deadman's Bay.
Pigstone Bay
Pigstone
Skomer Head.
Tarn House
The Basin
The Wick
20°
High Cliff
The Mewstone
Sedimentary Rocks.
Basalt
Felsite
1. Position of tent
2. Where flint implements were discovered.
On Wooltack Head.
Scale 2 inches = 1 mile

Geological Notes on Skomer Island.

By F. T. HOWARD and E. W. SMALL.

Read in the Biological and Geological Section, December 5th, 1896.

I. *Previous Literature.* Whilst the northern shore of St. Bride's Bay has long been made familiar to geologists by the classic researches of Dr. Hicks upon the strata in the neighbourhood of St. Davids, the Southern margin has not hitherto attracted so much attention, and comparatively few brethren of the hammer appear to have visited the outlying island of Skomer. De la Beche * mentions the presence of a 'quartzose and striped cornean,' of 'bedded greenstone' near the landing stage, and 'massive compact greenstone' in the north of the island. Murchison † gives a section which it is difficult to understand, and indicates the presence of upper Cambrian rocks, and many flows and dykes of igneous origin. Rutley ‡ gives a microscopic description of some Skomer rocks which had been collected by Ramsay, and placed in the Jermyn street Museum, especially of a very curious banded and spherulitic felsite, and Teall § includes a short description of Skomer basalts and porphyrites in his enclyclopædic "British Petrography."

None of these authorities, however, give exact localities, and we have, therefore, thought that the results of a hasty survey, made during two short visits to the island (in 1893 and 1895), might be worth recording.

II. *General character and arrangements of the Sedimentary and Igneous Rocks.*—After some search we succeeded in finding a simple base line in a well-marked ridge of conglomerate, running from the west side of the Wick in an east by north direction, terminating a little

* Trans. Geol. Soc., 2nd. series, vol. II.
† Silurian System.
‡ Q.J.G.S. XXXVII (1884).
§ British Petrography, p.p. 224, 284, 336.

to the north of Welsh way. Along the north of the Wick a well-marked dip-slope has been formed. This conglomerate consists of large pebbles of white felsite, as well as some of granite and greenstone, set in a siliceous matrix. Beneath it are finer conglomerates, sandstones rich in felspar, and red shales; while above it finer beds occur to the south, along a valley between the conglomerate ridge and the mass of basalt which forms the southern promontory of the island. The junction between the basalt and sedimentary beds, as seen in the cliff near High Cliff, appears to be a conformable one, but in the Wick the basalt is brought up by a fault very sharply in a perpendicular wall (which forms the cliff at the south of the Wick), so as to rest against the truncated edges of the sedimentary rocks.

The sedimentary beds are followed to the north-east by a basalt, which unmistakably passes beneath them; farther to the west they are in contact with a highly siliceous banded and spherulitic felsite, weathering white, and shewing spherules up to several inches in diameter. (This is the felsite described by Rutley, and is, probably, the striped quartzose cornean of De la Beche.) The rock seems to have only small spherules in the upper part, and to get coarser on the east side of the Basin, and finer, with more perfect flow-structure, on the west face of Tom's House.

It is difficult to clearly make out the relations of this rock with the surrounding ones, as the ground, inland, is mostly covered with bracken and coarse grass. In the cove, west of Tom's House, a basalt is seen on a dip slope, which appears to pass quite regularly beneath the felsite. Following the coast round to the N.W., all the rocks are found to be of basaltic type, up to a point a quarter-of-a-mile to the N.N.W. of Bull Hole. Here we meet with felsite again, occupying the northern-most portion of the island, including the outlying Garland stone The basic rock begins again where the wall, running due north from the farm, reaches the cliff, and can be traced along the cliff to North Castle, and thence along the western shores of North Haven and South Haven to the junction with the sedimentary beds near Welsh Way.

All the rocks inland are basic in character. Whether they are all of one series, or whether there are several sills, cutting through older flows, it is difficult to say. A curious series of ridges, running across the island in a more or less east and west direction, would seem to suggest the outcrop of dykes or sills, and the junction of felsites with basalts would be most easily explained in this way. Beginning at the north of the island, the first of these ridges is formed by the outcrop of felsite. To the south of this there are five fairly distinct ridges of basaltic character, viz., one from the Table Rock, by Bull Hole, to the end of the wall running north from the farm; another very marked one from the Spit to Waybench; a third from the Pigstone Rock, through the north yard of the farm, to North Castle (very prominent eastwards from the farm); another from Skomer Head, by the flagstaff, south of the farm, to North Haven; with a smaller one, appearing only as low

'humps' in the fields, a little to the south. Farther to the south again are the short ridge of sphærulitic felsite, the well-marked conglomerate ridge, already referred to, extending from the point west of the Wick to Welshman's Way, and the basalt ridge running from the south of the Wick to High Cliff.

A glance at the map of the island will shew that the small eastern portion, called the Neck, is joined to the main part by a narrow isthmus. This is formed of sedimentary beds, which can be examined at low tide in the South Haven, where, on the east side, the following section can be seen.

Basalt, with much epidote in veins, calcite, and a red zeolite in amygdaloids.
Light grey well-bedded sandy shale.
Hard red quartzite, interbedded with sandy shales.
Light grey sandy shale.
Basalt, at least 8 feet seen.

The beds are so much crushed and faulted that it is impossible to make out a clear succession. On the west, these beds are faulted against the basalt. Sedimentary rocks of the same character are found at the Rye Rocks, and in the cliff on the east side of North Haven. At an inlet, about 200 yards E.S.E. of the Rye Rocks, they pass under a basalt which, apparently, forms all the remaining portion of the Neck.

III. *Influence of the Geological structure on the Geography.* The two marked inlets of North and South Haven have, evidently, been formed by the more rapid erosion of the sedimentary beds. The fault on the west side of the Haven has thrown back the outcrop of these beds for about 200 yards. The Wick has clearly been eaten out along a line of fault between the basalt and the sedimentary beds. The ridges running east and west across the island have already been referred to. The farm house has been built behind one of the most marked of these, in the middle of the island.

The water supply is good. There is a strong spring at the base of the conglomerate, forming a small stream, which runs down to the Wick, east of Tom's House. Another, near the base of the felsite, has washed out a course immediately west of Tom's House. A brook, starting near the base of the sedimentary rocks, runs down to South Haven, near the junction with the basalt. There are also small streams near the Pigstone Rock, Bull Hole, and west of North Castle. The larger streams, in the middle of the island, probably rise out of the surface soil only.

IV. *Relation of the Rocks to the other Islands and the Mainland.* (*a*) GRASSHOLM. This is a small island, about seven miles to the west of Wooltack Park, which, from its position, apparently represents an exposed portion of a ridge between Pembrokeshire and the South-west of Ireland. No sedimentary rocks were found, the island being formed entirely of a black dolerite, in which felspar and a reddish mineral, probably due to alteration, can be seen. This dolerite is of a type not actually found on Skomer. (*b*) MIDLAND. This small island, between Skomer and the mainland, consists of a mass of basalt, very similar in

character to that on the east side of Skomer. (*c*) Wooltack Park. Along the south side of this promontory some grits and shales occur, which closely resemble those of Skomer, and have the same general dip. The basalt, which is found along the north side from Wooltack Point to Martin's Haven, rises from beneath them. Fossils are recorded from these beds in the memoirs of the Palæontographical Society (Davidson, Silurian Brachiopoda), but we have not yet succeeded in finding any, either here or on Skomer, and it is possible that those recorded, Pentamerus oblongus, P. globosus, Orthis elegantula, really came from a point a quarter of a mile farther to the east. Hitherto, the beds have been regarded as of Ordovician age, chiefly on the evidence afforded by the rocks in Musclewick Bay, where Asaphus, Trinucleus, &c., occur, in black cleaved slate. These Llandeilo beds are faulted against the Old Red Sandstone on the north, and the junction, with igneous rocks on the south, seems also to be a faulted one. If faults could be presumed absent, Llandovery beds should occur about Wooltack Park, so that we are inclined to regard these sedimentary strata, and the corresponding beds on the island of Skomer, as of Upper Ordovician or Lower Silurian age.

V. *Evidences of Ice Action.* Having already found, in almost every valley on the mainland opposite to Skomer, distinct evidence of the action of icebergs or an ice sheet which came down the St. George's Channel, we expected to find proofs of glacial action on the island. We found no glacial striæ on the rocks, but saw a large number of travelled blocks, some of which appear to have come from the St. David's district. The largest block is a felsite, just south of the brook running down by the Pigstone. It measures, roughly, 16 feet by 13 feet by 2 feet. Smaller felsite boulders are very numerous, especially on the basalt knoll north of Bull Hole, and in the valley just to the south. Some of the felsites may be local, others, probably, come from St. David's, or possibly from North Wales. Small boulders of Brimaston granite are found in the little brook running into the Wick, and in an old wall just north of Bull Hole. On the north side of the island some boulders of diorite, like that of the Precelley Hills, in North Pembrokeshire, occur, and near North Castle a few blocks of grit are found. Flints of various sizes—usually rounded—are scattered about the fields, as well as boulders of oolitic limestone. The latter, probably, were brought by man.

VI. *Microscopic characters of the rocks.* We have examined a large number of thin slices of the various rocks occurring on the island and the neighbouring parts of the mainland. The following are some of the chief varieties. (*a*.) Sedimentary Rocks. The grits found on the island and on the mainland all shew the same general character, consisting of clear quartz grains with the angles rounded off, a felspar weathered beyond recognition, and, rarely, some mica. A granite pebble from the conglomerate ridge is, undoubtedly, from the same mass as the Brimaston granite of the St. David's area; there are also pebbles of felsite, some showing good flow structure, and of basalt.

(*b.*) Felsites. The felsite of the Garland stone, in the extreme north of the island, shews phenocrysts of felspar, in a brownish felsitic ground mass, exhibiting extremely good flow structure. Some of the felspar crystals shew the Carlsbad twin with straight extinction, others are singly twinned, giving oblique extinction with crossed nicols, and a few shew multiple twinning. Most shew some alteration, and some are largely kaolinized. Fairly clear quartz occurs, somewhat corroded. There are several dark, irregular, patches of stained material sometimes encasing felspar crystals, and crossing the lines of flow in places, more or less, at right angles, are certain lines which seem to be decomposed felsitic matter in the form of minute crystals of quartz and felspar. The felsite of the cliff opposite the Garland stone shews fewer phenocrysts, and no definite flow structure.

A slide, cut from the base of the spherulitic felsite on the south of the island at Tom's House, shews no porphyritic minerals. The greater part is light brown with darker portions, the remnants of small spherulites which were once numerous, some being still fairly well marked. Certain bands are clear, and contain small quartz crystals. The rock shews, macroscopically, exceedingly good flow structure, which is not so evident under the microscope. A section, cut from the more coarsely spherulitic part of the rock to the east of Tom's House, shews five well-marked whitish spherules (of about $\frac{1}{6}$ inch diameter), in a greenish granular ground. The spherules are much cracked. They show dusty brown material in concentric bands towards the edges, but become more transparent in the central portions, except where patches of opaque material occur. Under crossed nicols a well-marked fibrous radiating structure is apparent, but the crystallisation is somewhat confused, and the spherules do not show a clearly defined black cross. In two places the slide shews patches of crystalline character, which appear to be basaltic inclusions.

This rock is, doubtless, as Rutley maintained, a devitrified obsidian, or glassy acid lava, and he remarks upon the close resemblance in minute structure between this Skomer lava and the Tertiary lavas of the Yellowstone district in the United States. It is, probably, near akin in character, and possibly also in age, to the felsites of North Wales. (*c*) Basalts and Porphyrites. The rock seen at the Table, on the N.W. coast of the island, is a porphyritic basalt, with large felspar crystals, shewing very distinct crystal outlines, some olivine, a little augite, and numerous opaque granules of magnetite, or ilmenite. That found at the north side of Bull Hole is a basalt, or porphyrite, shewing phenocrysts of felspar, with good crystal faces, and well developed cleavage. The alteration has obscured the twinning. The small lath-shaped felspars shew a distinct flow structure, and are seen to bend round the larger crystals. There is some dark ilmenite, and also some serpentinous pseudomorphs.

The Skomer Head Rock is a basalt—ophitic in parts—with lath-shaped felspar crystals, much augite, some of which is quite fresh, and

shews bright colours with crossed nicols, magnetite or ilmenite, and greenish decomposition products.

The basalt of the Pigstone Rock shews good phenocrysts of felspar in a fine-grained dusty ground-mass. The augite is small, and mostly altered.

The slides cut from specimens obtained from the west side of Tom's House, the cave at the bottom of the Wick, the west side of South Haven, and from North Castle, all show porphyritic felspars, often with good crystal outlines, granules of augite, and much ilmenite and magnetite, sometimes shewing crystalline form. These rocks may all be termed porphyritic basalts. The rock from the Neck opposite Midland is a porphyrite, shewing fine laths of plagioclase, felspar, and much black granular material, probably ilmenite, with no phenocrysts. Another porphyrite occurs on the mainland, by the keeper's lodge, just outside Wooltack Park; it shews small lath-shaped felspar crystals, rather decomposed, in a greenish brown matrix, and has circular holes filled with secondary quartz, &c., round which the felspars seem to bend. The basaltic rock of Wooltack Point shews good porphyritic crystals of felspar, in a ground of finer felspar microliths, granules and rough cubes of magnetite, and small augite crystals. The rock just inside the gate of Wooltack Park appears to be the same, but the phenocrysts of felspar are more numerous, and there is more of a greenish decomposition product.

GRASSHOLM. The whole island is composed of a volcanic rock of distinctly basic character.

The lathshaped felspars are small, sometimes arranged in skeleton crystals, but do not exhibit fluxion structure.

There are, in addition, crystals of augite and larger crystals of olivine most of which are altered—some into a curious mineral *Iddingsite.*

A small portion of a rock of lighter character was cut, and probably belongs to a volcanic ash.

Veins of secondary quartz and epidote cross the rock in every direction.

The presence of olivine in abundance distinguishes the Grassholm from the Skomer type of basalt.

EXPLANATION OF PLATE.

FIG. I.—Felsite. Garland Stone, showing good flow structure. × 6.

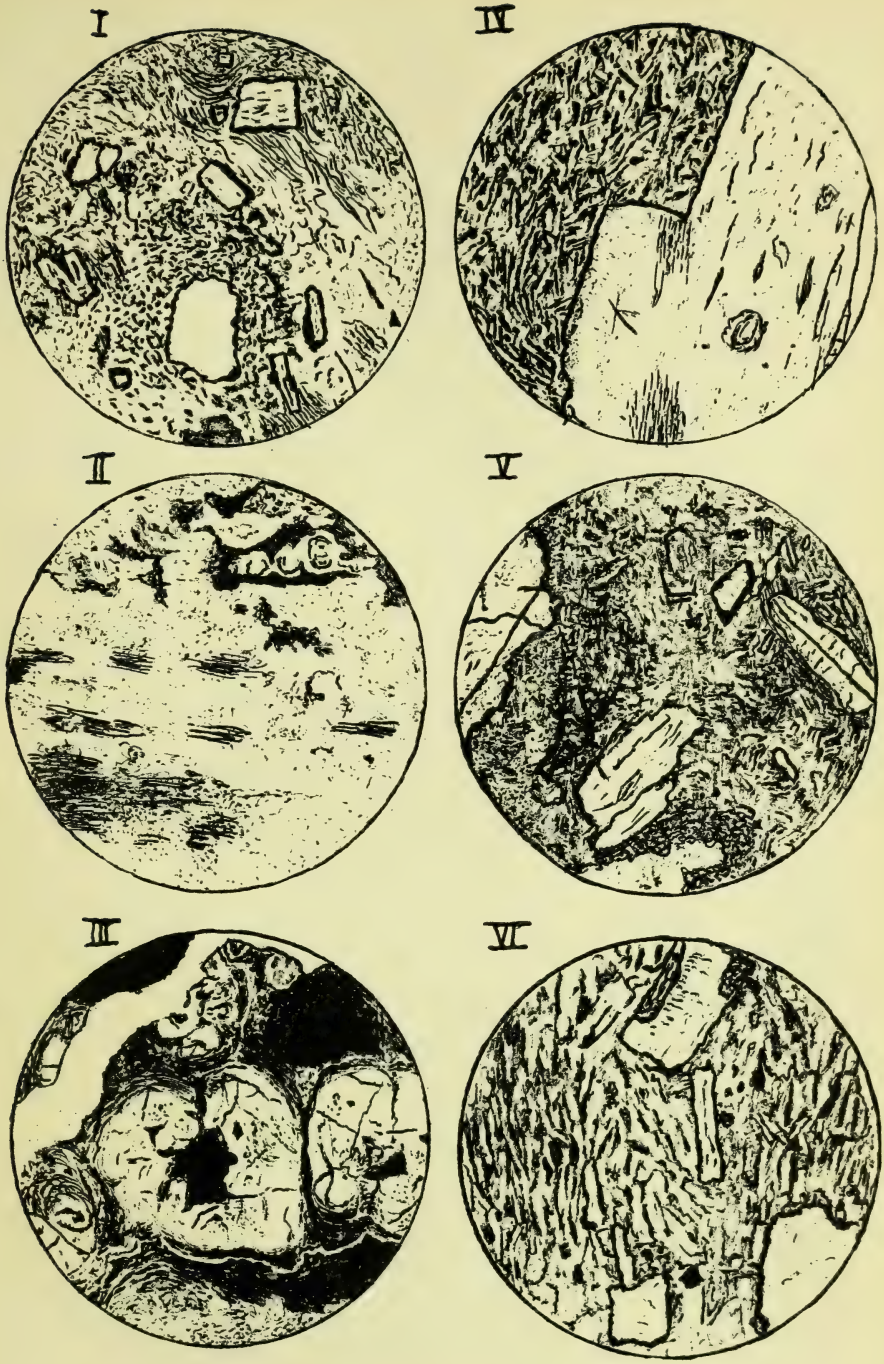
FIG. II.—Felsite. Base of cliff west side of Tom's House, showing spherulitic and flow structure. × 40.

FIG. III.—Felsite. East side of Tom's House, showing good spherulitic structure × 6.

FIG. IV.—Basalt. Table Rock, showing felspar phenocryst and lath-shaped felspars, indicating flow structure. × 40.

FIG. V.—Basalt. Midland Island, showing felspar phenocrysts. × 40.

FIG. VI.—Basalt. Bull Hole, showing good flow structure. × 40.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An Island Holiday.

With Vagrant Notes on Natural History.

By R. DRANE, F.L.S.

Read to the Biological and Geological Section on December 5th, 1895.

We meet to-night,—with subjects dealing
Which prove, "Community of Feeling"—
A phrase which in Phre-nol-o-gy,
With needless letters, spells 'a lie.'
But let us not that lie receive;
Our object is not to deceive
Ourselves or others, but to prove
That truth alone is that we love.

ON Saturday, June 1st, 1895, I went down to Milford, with Mr. Neale and a party of friends, intending to re-visit Grassholm But the sea was too rough even to approach that island, so the intention had to be abandoned, and we determined to go to Martin's Haven, pitch our tents upon the mainland, and thence visit the adjacent islands by boat. I secretly disliked this change of plan. Grassholm has such a strange fascination and romance about it. There white-winged Gannets round you sail, and Sea-dows love, and wild mews wail. It is at once so near, and yet so remote; so weird, and blank, and solitary, yet still within the kingdom of mankind. So barren and inhospitable, yet so secure and compassable, primitive and free, that it becomes, at once, one's own estate in fee. I was, therefore, grievously disappointed, but "went on, saying nothing," seeking consolation in that irritating "refuge of the destitute"—"Perhaps it is all for the best," and it was. Commonplace again scored one: Triteness justified itself, and disappointment smiled on happy uncontent. The Fern Owl came at eventide, as the nightfall gloomed west, and 'neath its silent wings we sunk, insensibly, to rest. Next morning,

charged with excitement to the muzzle, we rowed away to Skomer. The water was alive with birds, which scarce gave passage to our boat, and though they ducked and dived, admitted a community. They did not know us, for then, "Hell hounds by you, we are destroyed," those luckless birds had cried. Amongst this host of puffins, shags, and gulls, we saw, unmistakably, one Ringed Guillemot (*Uria lachrymans*), The specific distinction of the Ringed Guillemot is denied, and I agree that the difference, which is apparent, is apparent only. We soon landed on the island, which is, in some sense, more interesting than Grassholm. It is much larger, and has abundant vegetation. There is also a farm-house upon it, whose occupants gave us welcome and new milk. A king is he who is content, nor doubted we *our* high descent; we lapped the milk as they would do, who *would* have had some whisky too. I observed nothing of special interest in the vegetation, that is, nothing peculiar to the island, or unusual. But there were birds of whose habits I had, hitherto, no other than book knowledge. These were the storm petrel, shearwaters, cormorants, and shags, all of which breed on this island; and in regard to my reference to them, my hearers must be lenient critics; for this, my acquaintance with them, was but of a few hour's duration. As to the shearwaters,—two species frequent this place; and of these there was evidence only of one (Puffins major) in the crania which we found. The other (Puffinus anglorum), Manx Shearwater, was present in the flesh, and nesting, for we took both birds and eggs. This shearwater breeds in holes, like other petrels and puffins, which holes might be mistaken for rabbit burrows. Mr. Neale, by some, to me, unknown faculty, knew that a certain hole contained a shearwater. He thrust in his arm and fetched out the bird, and, of course, we assumed that the next thing would be its egg. Again he thrust in his arm, and brought out—not an egg—but a puffin. A third time he thrust in his arm, and brought out the egg of—neither! Here, then, two species occupied the same hole—a most unusual circumstance. To which did it rightfully belong? I know not, but to the shearwater, I think, because the shearwaters arrive and take possession in January, the puffins come much later. But why this association of species so different? Mr. Neale found the two species in the same hole. How was that? He has a gift, as they whose birth proves them, not made of common earth, his vision sees the hidden treasure full three feet underground, *by measure.* I think Mr. Neale's faculty of seeing the invisible consists in his possession of a superior kind of "divining rod." I say "superior," because I do not wish to associate his name with the delusion and quackery so intimately connected with the ordinary article, for his gift lies in his capacity, and not in his pretence.

The shearwater, thus first brought out was a beautiful bird, delightfully sleek and clean, with the charm and mystery of unfamiliar nature about it. The Turks say "The stranger filleth the eye." None of the shearwaters vomitted the abominable oil, which petrels will sometimes emit. It was thrown up into the air, but bungled its restoration to

liberty, seeming quite dazed, and was only too easily retaken. Again it was thrown up, and again it blundered, like an owl exposed to the noonday sun, only much worse. We found others, one of which I brought home alive; they all behaved in the same helpless way. We found their eggs, pure white, and very like the puffin's, but without its obscure maculation. These birds are so nocturnal in their habits, that persons, familiar with the island by daylight only, might live surrounded by them and not suspect their presence. At night they come out, and are active enough. It is then that their singular weird cry is uttered (why is the seabird's cry always melancholy?) I heard it, as I lay awake in the tent. There was no noise of wings, no evidence of living thing, when a ghostly voice said in plaintive key, as of one who wept, "Cuckolds in a row," with distinctest articulation, and again, as distance softened down its grief, "Cuckolds in a row," until, still further off, was echoed back, as if it passed some door that closed behind, "Cuckolds in a row." I fear my phraseology may suggest that Thalia here takes on the functions of Melpomene, but I am quite serious, and if I *do* allow some licence to ideas, I'm still within the rigid lines of truth and soberness. Science must be unalloyed, but she need not be stark, old, and angular—a frigid, prude, despising dress. The Greeks were in no confusion as to the distinction between Aphrodite and Minerva. Eros they gave to Aphrodite, as to shew the union of Beauty, Love, and Youth; but from Minerva (the thinking power, inventive faculty of mind), *they* did not withold the eye, the form, the comeliness, which captivate mankind.

There is something about the conditions of birds of the petrel family which needs close observation, study, and elucidation—elucidation which I cannot give; study for which fate witholds the basis, observation. So ignorance is apt to bring forth heresy, and superstition, error. Thus far I am disposed to the belief that the birds of this family do not enter the water as they are assumed, and very naturally assumed, to do; for I have now had three species in confinement, the Stormy Petrel (Thalassidroma Leachii), the Greater Shearwater (Puffins major), and the Manx Shearwater (P. anglorum); and in each case I find that when these birds really enter the water, they make strenuous efforts to get out of it, and that, succeeding, they are so drenched as to be incapable of flight, as I have demonstrated in this room. This statement has been met by the suggestion that the unnatural conditions of confinement effect a change in the quality of the plumage, which might account for this saturation;—remembering this, I immersed my shearwater in the sea within an hour or so of its capture, and the result was the same. Be the explanation what it may, this fact remains, as the result of repeated observation, that I cannot drench a duck or a gull by immersion, and that I cannot immerse a petrel without drenching it. I know that my belief is opposed to theory and natural inference, still, explain it who may, so forceful is fact, it will have its own way. I have failed to tame any of these birds, or induce them to take food spontaneously. (*For further observations see forth-*

coming paper). I can tame most creatures easily. This is my recipe: Take of sympathy, patience, noiselessness, food, warmth, and gentle handling, of each a heartful, and administer daily, *ad lib.* Before leaving this question, I would just refer to the meaning of the name—Petrel, is little Peter; that is, one who *treads* the water, and seems partially to sink in it. I am inclined to think that an imperfectly apprehended fact in Natural History is imbedded in the name, and that this family is not truly aquatic at all.

I have said the cormorant (Phalacrocorax carbo), breeds on Skomer. This is not mathematically precise, for it affects a rock called the Mewstone (that is, gull's rock), separated from the island by a deep water-filled fissure, across which a man could jump, *if* a man were a kangaroo, and *if* the kangaroo were a strong adult, and *if* I have not over-estimated its agility. This rock rises abruptly from deep water to a hundred feet or so, and a steady head, a sure foot, and a firm hand are required to land upon and climb it; but, given these conditions, it is easy enough. Here it breeds abundantly, though not under its characteristically favourite conditions. Its large, coarsely-built nests are found on ledges of rock overhanging the sea, a hundred feet below; but it prefers caves, which its habits make intolerably noisome. It is, indeed, an obscene and stygian creature. It belies the very name of bird, with which is generally associated some idea of the angelic, but this one is a demon, and a very dirty devil. It has all the predatory meanness of a money-lender, and none of the dignity of the raptorial eagle, or, for that matter, of the great black-backed gull, a truly noble bird. Its bill, its colour, form, and plumage, its hideous and unnatural feet, are all suggestive of evil. I know we men are murdering butchers, pleading necessity, and the command, "Arise, Peter, slay and eat." We kill and eat the helpless, young, and innocent; calves, lambs and hares; but we do not carry their blood and its odour with us wherever we go. This bird does; but I need not enter upon its general natural history: Behold it is written in the book of the Chronicles of the Kings of Ornithology. We saw its young, naked, sooty, saturnine, black, and ugly in their downy infancy. We took its eggs—we brought away an entire nest for the Cardiff Museum. The God of mercy need not be here*in* propitiate, for "mercy he has, who merciful is." Why should not *be* these horrid birds exterminate? "Whatever *is*, is right." I know not why some things are so. From God we came, to God shall go, and feel that all our petty light is, as a gloworm's is, at night. This bird's egg is interesting in several ways. It is as much too small for the size of the bird as the guillemot's is too large. The length of the bird, and the combined axis and diameter of its egg, are as 11 to 2, those of the guillemot are as 6 to 2, or in other words, the egg is only half what it ought to be, when the guillemot is the standard; and that of the guillemot is twice what it should be, when the other is the standard. The egg is pure white, but this white is due to a soft chalky coating, easily rubbed off with a good nail-brush and water. When it is so removed, the egg appears of so pale and delicate a blue that

it might be called bluish-white. By transmitted light, however, it is of a bright emerald green. This green is visible only in this way, and if the surface is rubbed off, down to the interior white lining membrane, it cannot be found. Now it is curious to observe that the eggs of so many sea birds possess this invisible green—*e.g.*, the shag, cormorant, gannet, razorbill, guillemot, and some gulls, the surface of whose egg is brown.

I have specimens here so treated as to allow anyone interested to see it for himself.

The ordinary foria or fœcal excretion of gulls is a milk-white fluid. Its whiteness is due entirely to phosphate of lime, derived from their fish food; but the shell of their eggs is mainly carbonate of lime. How is the phosphate changed into carbonate—indeed, one might ask why is the phosphate transformed into carbonate? Phosphate serves for the making of bones, why not for egg-shells? That I can put these questions without answering them is an humiliating proof that I am not qualified to prepare a paper for you upon this subject. I can only suggest that the putting of the question is the first step, the go-cart stage, towards getting the answer. As a matter of fact, the egg-shell of the domestic fowl, which eats no fish, contains as much phosphate of lime as that of gulls which live on phosphatic food.

In preparing these eggs I found that the spots, which I had thought of as quite *as* superficial *as* the colour on the cheek of an apple, are not so, but stain the shell right through, and even more than that, there are spots *below* the surface, not visible *upon* it, which may be revealed by rubbing the surface away. I do not at all mean by this to suggest that the statement is of general application, nor even always so in the individual egg operated upon.

We visited another island in St. Bride's Bay known as the Stack Rock, for we were told there were many gulls there. The gulls were all dead, the nests all robbed. Our advent was that of those who seek reception at a "House to Let." We, representing man, the destroyer, found the house untenanted and desolate, like a place where "ships were drifting with the dead, to shores where all was dumb." The universal enemy here found himself alone. This island rises abruptly from the sea to the height of about 100 feet. Its area is very small, and upon its summit we found the mortal remains of eleven herring gulls, probably victims of the very severe winter, for they had evidently been dead some months. Here we were all well sea-beaten. How was that? Well, I can hardly tell you, but it was one of those incidents which may, at any time, happen to the adventurous who rashly wander into foreign lands. Here we found, growing in profusion, the Beta maritima, in greater luxuriance than I ever saw it before, so as to be quite unlike its ordinary self. This plant, the "dear departed" gulls, and the luncheon which we ate amidst the murmurings of the sea, light wind, and summer sun, were all that interested *me* here.

We took to our boat, a little disappointed, and returned across the bay. In doing so we saw, upon the cliff-top of the mainland, a pheasant

defending her young from a carrion crow, and watched the strategy of the two birds as long as the progress of the boat allowed. To me it seemed like a widow protecting her property and children from the cunning of an unscrupulous lawyer. We wished her success, and believe she succeeded.

We next helped our fishermen to raise and examine their nets. They contained nothing of value, except as bait for crab-pots ; one or two wrasse, and twenty-six dog-fish—hideous impersonations of evil—misshapen, gliding, sinuous sea-wolves, fit companions for shags and carrion crows—sharks, thieves, and murderers—a hateful trinity. The fishermen told us that crabs (here taken of enormous size, together with lobsters and cray-fish), are very clean feeders, and will not touch decomposing matter, while the more delicate and esteemed lobster is far less fastidious. We bought crabs and lobsters, alive, at a very low price and cooked them ourselves, as gypsies do hedgehogs, under a hedge, of course, for their flavour is not good if brought into a house. The crabs were too large, or our saucepan too small, so we had to boil them one half at a time, and when that was done, turn them round and do the other half. Having rested, we went a wandering on foot. We found three dead badgers which had been thrown over the cliff, as criminals from the Tarpeian Rock, their crime was the killing of rabbits. (*Vide* Law Reports, " Pence *v.* Nature.")

We caught three mice, which were very like the house-mouse, except in colour, and bit like true rats. There was no inhabited house within a mile. The wood-mouse does not bite, and they were certainly not voles. I brought them home for examination, hoping to add another variety to our fauna, but they were decomposed and useless.

On the cliff-tops we saw the carrion crow at his old game amongst the plovers. Here it was not one against one, as with the crow and pheasant, for the plovers combined to flout the crow and worry him from the field. He had not the courage to fight, but I daresay the cunning thief managed to get a chick or an egg for his dinner, the plover, by far the weaker, was more spirited, and I would that the fate of Sennacherib had overtaken the crow when, " The might of the Gentile, unsmote by the sword, was melted like snow in the glance of the Lord." Mr. Trow found abundantly, and in different places, a variety of the common broom (Sarothamnus) which had completely lost its usual erect habit, and become as completely procumbent. As seen from a distance, lying flat on the ground, and in full bloom, it looked very like masses of Lotus corniculatus. This variety exists hereabouts, to the entire exclusion of the erect form, and must be propagated by seed, for it grew in many places, some of them so sheltered, that the suggestion of its form being due to the force of the prevailing wind is not tenable. Nor did the individual plants grow in one direction, but equally in all. I could find no very small plants, so I brought home a mass of it, in the hope that some gardener friend might strike cuttings from it. I gave some to three such, two of them succeeded, and I have 4 young plants.

Another variant from the usual type was abundant in a white form of the common dog violet—viola canina.

I forgot to mention in its right place a suggestion of Mr. Neale's, which strikes me as worthy of consideration, and interesting from its probability. Amongst the other birds breeding on Skomer, the oyster-catcher made itself noticeable by its vociferous protests against our intrusion into its domain. Mr. Neale thinks it is thus vocal only *after* its young are hatched. This requires confirmation, but I incline to think that it is so; for Mr. Neale found an oyster-catcher's nest with eggs on the Stack Rock, from which the birds fled silently away. Here shows itself the 'prentice hand, but the apprenticeship to the knowledge of Nature's laws is a long one, and we are not *all* Newtons. "Nature and Nature's laws lay hid in night. God said—Let Newton be,—and there was light." Thus far we have been amongst migrants, and as I have said all I have to say of this our visit to the far West of Wales with a consciousness of how little 'tis, let me too migrate, now, to St. George's Island, near Looe, off the south coast of Cornwall, where I became Mr. Neale's guest, on the 25th of June. Here I found Mr. Neale, Mrs. Neale, and quite a number of young ones, living inside a mouse, and the only one upon the island, for I took traps with me to catch one for myself, but failed to find one; it did not matter, for there was plenty of room for me in Mr. Neale's mouse. We were the sole occupants of the island, except a keeper, who, oddly enough, I found living in a cat. This is no fairy tale, or child's story, for, in the brave old days of the smuggling industry, there was here a house with an undiscoverable cellar full of kegs. The authorities knew all about it, but they could not catch the smugglers, nor find the cellar. The place was searched in vain, again and again, till one might doubt the existence of the mysterious vault, did it not remain to this day; but how it was concealed was never known till the secret became not worth the keeping on account of the depression of trade. For sufficiently obvious reasons, the Revenue built a house on the island as near as possible to the secret cellar; so the smuggler's house was called "The Mouse," and the Revenue's house of observation, "The Cat." Our natural history, to the truth of which we are committed, has here become inverted, for this cat was much smaller than the mouse; take note that it is always very necessary to be precise as to species. I hate mice, and dislike cats. The cat is strong and cruel, it delights to torture the mouse, which is small and weak. This species of cat is specially hateful to me, for I am its mouse. It charges me upon a much higher income than I make. Now this is a fact in natural history, that when authority makes itself indistinguishable from oppression, it causes the dormant seeds of the lower passions to germinate and give a sweetness to their otherwise bitter flavour. St. George's Island is the wind swept and uncultivated home of thousands of rabbits. Its shore to the east is rocky, but low, on the west it is high-cliffed, and well nigh inaccessible. Its surface is kept almost bare by the rabbits, but there is a good sized space on its south-east, which is green with luxuriant Lotus corniculatus. A plant

of the clover family, so it seemed odd that it remained untouched by the rabbits.

On the inaccessible face of the western cliffs the rock-dove, kestrel, and carrion crow breed, we took the young of the two latter, when they were pleased to leave home. It would probably strike an inland observer, or one unaccustomed to a coast line of precipitous rocks, as singular to find these nesting in cliffs, as he would look for them in woods. Gulls do not affect the island. Their place is supplied by the rabbit and the rat, the rats live on the products of the sea, except when they do a little poaching. One evening the keeper shot at something which he thought was a rat playing or fighting with another: he found he had killed an old rat and a young rabbit of about its own size, and brought us their warm and bleeding bodies as a conclusive proof of the necessity of his own being. There is nothing new in the fact that rats destroy young rabbits, but there is a satisfaction in having personal knowledge of it. "Rattus delenda est." Is that a legitimate paraphrase? Just under the "Mouse" there is a tiny sheltered cove, where was always to be seen a gull (Larus canus), floating on the still, deep, clear water, and it was so little concerned at our presence that it was called "the tame gull." This bird was caught by one of Mr. Neale's sons, and put into the small walled garden attached to the house. Old and infirm, it had chosen this quiet cove in which to wait its end.

> What fitter place, on solemn sea,
> For life's last look to such as he?
> On parent's breast the seamew dies,
> While ocean stills her waves and sighs.

Its feathers were frayed and worn. They were, indeed, last summer's dress, for it had been too weak to moult. "But if I keep it clean it will last me now," it said—and it *was* kept clean by the life-long continued habit of its youth—the long-past glorious youth, whose joy it was to battle with the wave and float upon the storm. Its irides were silver white, and in its eye there shone a strange placidity, as if now free from doubt, suspicion, fear. It took food, when offered, with the air of one to whom there mattered nothing now. I have never, in wild life, seen so contentedly pathetic an acceptance of fate, as if it 'twas bright ahead, so calm behind, that no regrets shrieked out their impotent desires. "So gently worn, so sweetly weak," that it recalled for us the Prisoner of Chillon. Next morning, e'er we breakfasted, we found the link was snapped between ourselves and it; for the old gull's grey eyes had closed for ever on the sea. May our last ending be as his. Perhaps I have dealt in too great detail with this episode, but it is one so rarely to be witnessed that I would ask, who, here to-night has seen a wild bird die—incapable by age—who ever sees a bird in nature which is obviously old, worn, tottering, effete; it rather seems to have perennial youth. Where, when, and how, then, do they die, who quit "the precincts of the day, nor cast one longing, lingering look behind." One of our diversions here was the setting of nets at night and going

in the morning to see what might be therein for breakfast. We took wrasse, red mullet, salmon, herring, pollock, and pilchard. The wrasse (there are many varieties, some of them splendidly coloured), is as good as the perch, but is not esteemed. Of course, no one likes red mullet. Salmon, a very common fish. The herring is known to peripatetic philosophers (tramps) as the "Sea Pattridge," just as among gourmets the red mullet is its woodcock. The pollock is a "poor relation" of the cod family; and the pilchard, what of that? Pilchard fishing is a stock trade in Cornwall; thousands upon thousands are taken, yet nobody sees them in the fish shops about the country, where it is almost unknown, and I question whether there is more than one person present who has ever tasted a pilchard, or would know the fish if he saw it, unless he had eaten that delicious thing which is really caught, cured, and tinned in Cornwall, exported to France, there labelled, and thence returned to this country as the sardine. For years past I have eaten sardines under the impression that I was consuming Frenchmen, while I was really devouring the Tre-Pol-Pen of my own country. They have a different flavour now. Englishmen are not nearly so nice to eat as Frenchmen.

I have just one ineffectual fact to note of one of these fish—the red mullet. When taken from the water it is not red, but of a very palid colour, as if the victim of anemia. The fishermen, therefore, strip off its large loose scales, and in a few minutes it assumes the colour which is familliar to us. The living mullet, *in* the sea, is no more red than lobsters *be*. The assumption of this red colour, I suspect, is due to the rapid oxidation of a principle existing in the tissue underlying the scales. I seperated this tissue and put it into chloroform, and obtained a solution which, after the chloroform had evaporated, left a fat of an orange red colour. Here is that obtained from a large high-coloured red mullet. Now this fat would not give to the mullet the true red colour of the creature as we know it, and, I think, there are two colouring principles of different characters in the membrane. This is a matter of investigation which, thus far, I have not had the time to pursue, and the bare fact remains, that that which gives this fish the main part of its colour is a fat soluble in chloroform.

I have now arrived at the closing episode of my story. On the last day of my visit, we went out fishing by a method here called "whiffing," that is, with a baited hook at the end of some 60 feet of line, drawn through the water from the stern of a boat rowed slowly. Finding ourselves close by the "Ore Stone," a precipitous rock rising from the sea, we saw on its summit two young birds. We landed, climbed the rock, caught the birds, and descended backwards to the boat. These birds were the callow nestlings of the Great Black-backed Gull, here called the "Cob," which means "Big." One of them passed to Mr. Neale, and one came home with me, and I have it living now. When taken, it had not a feather yet developed, and was as large as early ducklings, when they come, bearing their green peas with them. Now it is as large as a goose, and clothed in a spotted dress of white

and grey-brown, without any indication of its very different adult costume. It is a powerful, fearless, aggressive bird, with very strong wings, and a formidable beak, which it uses freely to bite, by way of attack or reprisal, and pinch a fish throughout its whole length, so as to break its stronger bones and make it more supple to swallow ; then it is bolted whole, head foremost. The fish, a bright fresh mackerel, or herring, after the pinching process, has as completely lost all self-respect as he who, being drunk, gets home, through drenching rain, somewhere between midnight and breakfast-time. Sometimes it will cast up the perfectly exhausted skeleton of a fish's head, or other indigestible element of its food, as an ordinary part of its economy, and vomit the whole contents of its stomach, if hunted or alarmed. The Genus Lestris (Skua-Parasitic Gull, often called Dung bird), is well aware of this weakness in the gulls, whom they pursue, and take from them the meal which they do not choose to earn by their own legitimate industry, and it is a mistaken conception of the food, thus obtained, which explains their local name. It is very fond of raw liver, but will take all manner of animal food and soaked bread. It is capable of very strong attachment, when it becomes gentle and inoffensive, liking to be stroked, and even nursed. It is on terms of the closest intimacy with the housemaid, and will harshly scream, when it hears her step, calling her to come to him ; she goes, and he then changes his tone completely, and speaks to her in a low, whining, or weedling voice, which is, to its other utterance, what the soft words of lovers are to ordinary conversation,—when she departs the bird will call after her, beseeching her to return. She promises to do so, and seems to be understood, for the gull, with a snivel, resumes its usually unbroken silence. His manner to the cook is the very opposite. It greets her with its loudest and harshest cry, with wings outspread, stretched neck, and open mouth, seizing her dress with his bill, and driving her away. This is not the result of illtreatment, for the cook is good natured, likes the bird, and wishes to be on friendly terms ; but no, he will have nothing to do with her ; and I think it is simply that his whole heart is bestowed elsewhere. For me he has a third quite different manner. I have had to teach him that I am master, simply as a matter of strength and will, not as one of punishment or harsh usage ; so he regards me with suspicion, which he expresses by a drollery of attitude, born of prudence, defiance, humour, and distrust. You are now, I imagine, sufficiently gulled, so " I looks towards you, and I likewise bows."

A little bird told me another member of this section is prepared to give it some notes upon the habits of this bird. I have, therefore, said enough, and he will tell you something which, except on such authority as his, would hardly be credited.

Geological Notes.

By F. T. HOWARD.

(Read in the Biological and Geological Section).

An Ichthyosaurus Jaw from the Lias of Lower Penarth.

The Lias beds of the neighbourhood of Penarth have yielded many remains of Saurians, differing in type from those so well represented in the Rhaetic beds below.

Teeth and vertebræ of Plesiosaurus are frequently obtained from the conglomerate at the base of the Rhaetic, but those of Ichthyosaurus are comparatively rare.

On the contrary Ichthyosaurus is typical of the Lias whereas Plesiosaurus is but rarely found.

In the Cardiff Museum, besides the perfectly preserved skull of Ichthyosaurus communis obtained by Mr. Storrie from the top of the Ostreazone, there are portions of the vertebral column of the same species from Lavernock Point and the Cwrt-y-vil Quarry, and disconnected vertebræ from Penarth Head, Cogan Pill, Llandough, and Leckwith from all the zones, from the White Lias upwards.

Ichthyosaurus platydon was also obtained from Lavernock Point by Mr. Cruttwell.

At the Aberthaw Lime and Cement Works, Lower Penarth, a portion of the vertebral column of a Plesiosaurus was discovered in the Ostrea beds (vide Proceedings XXV., Part II.). With the exception of the discovery at Liswerry in 1881, by Professor Sollas, this is the only important find of Plesiosaurus bones in the Lias of South Wales.

In the Summer of 1895 a specimen was obtained from a band of shale near the base of the Lias—one of the group of alternating thin limestones and shales, known locally as the "Pretty Beds." The zone is

several feet above that from which the Plesiosaurus remains were obtained.

The specimen was about 1 foot in length and consisted of the front portion of the snout of an Ichthyosaurus of small size. The block with the remaining portion of the head was destroyed before the fossil was recognised.

The teeth were distinctly shown, most of them remaining in position in both jaws, while others were lying in the rock immediately in contact.

From the slender character of the jaw and the teeth it is probable that the species is either Ichthyosaurus tenuirostris or I. longirostris.

A Deep Well-Boring at Cardiff Docks.

The number of deep wells and borings in the Trias beds of the neighbourhood of Cardiff has greatly increased since the construction of the Taff Fawr Reservoir. The water from that source contains only a small percentage of dissolved salts and is not well suited for brewing purposes.

The wells vary in depth according to the distance from the outcrop which runs along the south flank of Penylan westwards close to Maendy and on to Radyr.

At the Maendy brick-pit the Dolomitic Breccia is only a few feet thick and separates the clays of the Trias from those of the Old Red Sandstone below.

The Dumballs boring was for sometime the deepest known—418 feet.

It was determined to obtain a supply from the same beds for the Crown Preserved Fuel Works, situated near the Roath Dock. A boring was put down to a depth of over 400 feet but it did not provide enough water for the works. A second boring was begun in the summer of 1894. Progress was very rapid at first and by the end of September of that year a depth of 425 feet was reached.

The Dolomitic Breccia was not recognised, and the strata below a depth of 425 feet appeared to be similar in character to those already passed through.

The boring was therefore continued until a permanent change of colour set in. The Diamond drill was then employed and the boring was finally abandoned at a depth of 1,063 feet.

The cores so obtained proved that the boring had reached the Silurian strata. The rock was of a soft calcareous shale passing occasionally into an earthy limestone with fossils, among which were recognised : Strophomena euglypha, Rhynchonella Stricklandi, Encrinite stems, species of Orthis and Athyris.

Judging by the sandy character of the Ludlow beds of Penylan and the presence of thin limestones in the Wenlock series only, I believe that the cores must have come from the Wenlock zone.

According to the measurements taken by Professor Sollas at Rumney and Penylan, the Ludlow beds are about 360 feet thick. To this a little more must be added for the Wenlock beds above the calcareous horizon.

Unfortunately the boring did not prove the thickness of the New Red clay, but as the depth has nowhere in the neighbourhood exceeded 430 feet I am inclined to regard the red and variegated beds below that horizon as belonging to the Old Red Sandstone.

The junction of the Old Red Sandstone and Silurian is a matter of pure speculation also, but I should think the permanent change of colour together with the evidence of the thickness at Penylan and Rumney would place it about 550 feet.

Thus the boring would be about—

49 feet in Surface Beds,
371 feet in Trias,
130 feet in Old Red Sandstone,
510 feet in Silurian.

I do not suppose that these calculations have any value except as a help to the interpretation of the accompanying table.

SECTION AT THE DEEP BORING CROWN PRESERVE FUEL WORKS, ROATH DOCK, CARDIFF.

	Thickness. ft.	in.	Depth from surface. ft.	in.
Made ground, Alluvial clay and gravel ...	49	0	49	0
Red marl	68	4	117	4
Red marl rock, with green patches ...	299	0	416	4
Red sandy marl...	2	10	419	2
Reddish grey sandstone, jointed ...	9	5	428	7
Grey gritstone...	3	1	431	8
Reddish gritstone	3	10	435	6
Red sandstone	7	6	443	0
Red sandy marl..	8	0	451	0
Red and grey "gutty" marl ...	3	8	454	8
Red and grey sandy marl	46	10	501	6
Red and blue marl	17	4	518	10
Red and blue marl with sandstone layers	2	8	521	6
Variegated sandy marl	28	0	549	6
Grey gritstone...	1	2	550	8
Red and grey sandstone	7	9	558	5
Variegated sandstone with bands of hard grey gritstone	4	7	563	0
Red and grey sandy shale	5	0	568	0
Grey sandy shale	13	0	581	0
Light blue sandy shale	6	3	587	3
Grey gritstone	1	1	588	4
Light blue "bastard" sandstone ...	1	6	589	10
Light blue sandy shale	13	10	603	8
Light blue sandy shale with bands of grey sandstone	5	8	609	4
Grey "bastard" sandstone	5	0	614	4
Light blue sandy shale with bands of hard grey sandstone	9	3	623	7

	Thickness. ft.	in.	Depth from Surface. ft.	in.
Light blue sandy shale	18	10	642	5
Hard light grey gritstone	1	0	643	5
Light blue sandy shale	2	0	645	5
Hard grey gritstone	0	8	646	1
Blue marl	3	4	649	5
Light blue sandy shale	7	1	656	6
Hard grey gritstone	0	5	656	11
Light blue sandy shale with grit bands...	37	5	694	4
Red and blue sandy marl	9	8	704	0
Light blue sandy shale with grit bands ...	28	3	732	3
Variegated sandy marl	5	0	737	3
Hard grey sandy marl	1	9	739	0
Variegated marl with sandstone bands ...	13	1	752	1
Hard grey sandstone	0	9	752	10
Reddish grey and brown sandy marl ...	5	4	758	2
Light blue sandy shale	26	5	784	7
Hard grey gritstone	0	11	785	6
Hard grey shale with bands of gritstone...	2	1	787	7
Hard grey gritstone	2	1	789	8
Grey sandy shale	13	4	803	0
Hard grey gritstone	1	4	804	4
Dark grey sandy shales	9	3	813	7
Red and grey sandy shale	9	7	823	2
Hard grey gritstone	2	0	825	2
Hard grey gritstone with bands of shale	3	10	829	0
Grey sandy shale	17	4	846	4
Grey sandy shale with grit bands ...	1	6	847	10
Grey sandy shale	7	9	855	7
Hard grey gritstone	1	3	856	10
Grey calcareous shale	12	0	868	10
Red and grey sandy shale	4	0	872	10
Grey sandy shale	15	2	888	0
Grey limestone?	1	4	889	4
Calcareous shale	5	7	894	11
Grey limestone?	1	2	896	1
Calcareous shale	8	6	904	7
Hard grey limestone?	1	10	906	5
Calcareous shale	19	4	925	9
Grey sandy shale	11	10	937	7
Red and grey sandy shale	3	6	941	1
Grey sandy shale	3	6	944	7
Grey calcareous shale	27	11	972	6
Red and grey sandy shale	1	0	973	6
Calcareous shale	18	0	991	6
Sandy shale with red marl bands ...	3	0	994	6
Calcareous shales	12	6	1007	0
Grey sandy shale	7	0	1014	0
Hard grey sandstone	1	0	1015	0
Grey sandy shale	3	6	1018	6
Hard grey sandstone	0	6	1019	0
Grey sandy shale	7	0	1026	0
Dark grey close-grained calcareous shale with earthy limestone bands ...	37	0	1063	0

PEMBROKESHIRE COUNTY COUNCIL.

WILD BIRDS' PROTECTION ACTS, 1880-94.

NOTICE IS HEREBY GIVEN

That the following orders have been made by Her Majesty's Secretary of State, pursuant to the power conferred upon him by the Wild Birds' Protection Act 1894.

JOHN OWEN,

April 1st, 1896. Clerk to the Pembrokeshire County Council.

In pursuance of the powers conferred on me by the Wild Birds Protection Act 1894, and upon application by the County Council of the administrative County of Pembroke. I hereby make the following orders :—

1. The Wild Birds Protection Act 1880 shall apply within the County of Pembroke, to the following species of Wild Birds in the same manner, as if those species were included in the Schedule to that Act :—Buzzard, Honey Buzzard, Merlin, Hobby, Osprey, Hen Harrier, Choughs Nuthatch, Wryneck, Water Ouzel or Dipper.

2. The taking or destroying of the Eggs of the following species of Wild Birds is prohibited throughout the County of Pembroke, viz. :—Goldfinch, Honey Buzzard, Merlin, Hobby, Hen Harrier, Kingfisher, Nightingale, Nightjar, (Goat Sucker, Night-hawk or Fern Owl), Blackcap, Reed Bunting, Cirl Bunting, Chiffchaff, Dabchick, Dove, (Turtle), Wheatear, Whinchat, Flycatcher, Ring Ouzil Pipits, Redback Shrike, Tree Creeper, Garden Warblers, Wagtails, (all).

Given under my hand at Whitehall this 26th day of March 1896.

(Signed)

M. W. RIDLEY,

One of Her Majesty's Principal Secretaries of State.

GLAMORGAN

COUNTY COUNCIL.

Wild Birds Protection Act, 1894.

NOTICE IS HEREBY GIVEN

That, on the request of the County Council, Her Majesty's Secretary of State for the Home Department has made the following Order under Sec. 2 of the above-named Act, viz. :—

> "The taking or destroying of the eggs of the Kingfisher and Goldfinch shall be prohibited in any part of the County of Glamorgan."

Any person who shall take or destroy, or incite any other Person to take or destroy, the eggs of the Wild Birds named in the said Order, in contravention thereof, shall, on conviction, forfeit and pay for every egg so taken or destroyed, a sum not exceeding One Pound.

T. MANSEL FRANKLEN,

Clerk of the Glamorgan County Council.

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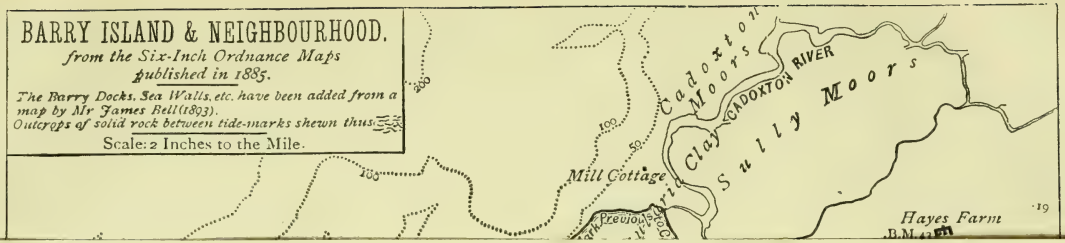
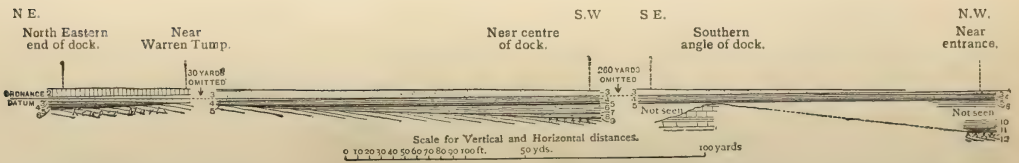
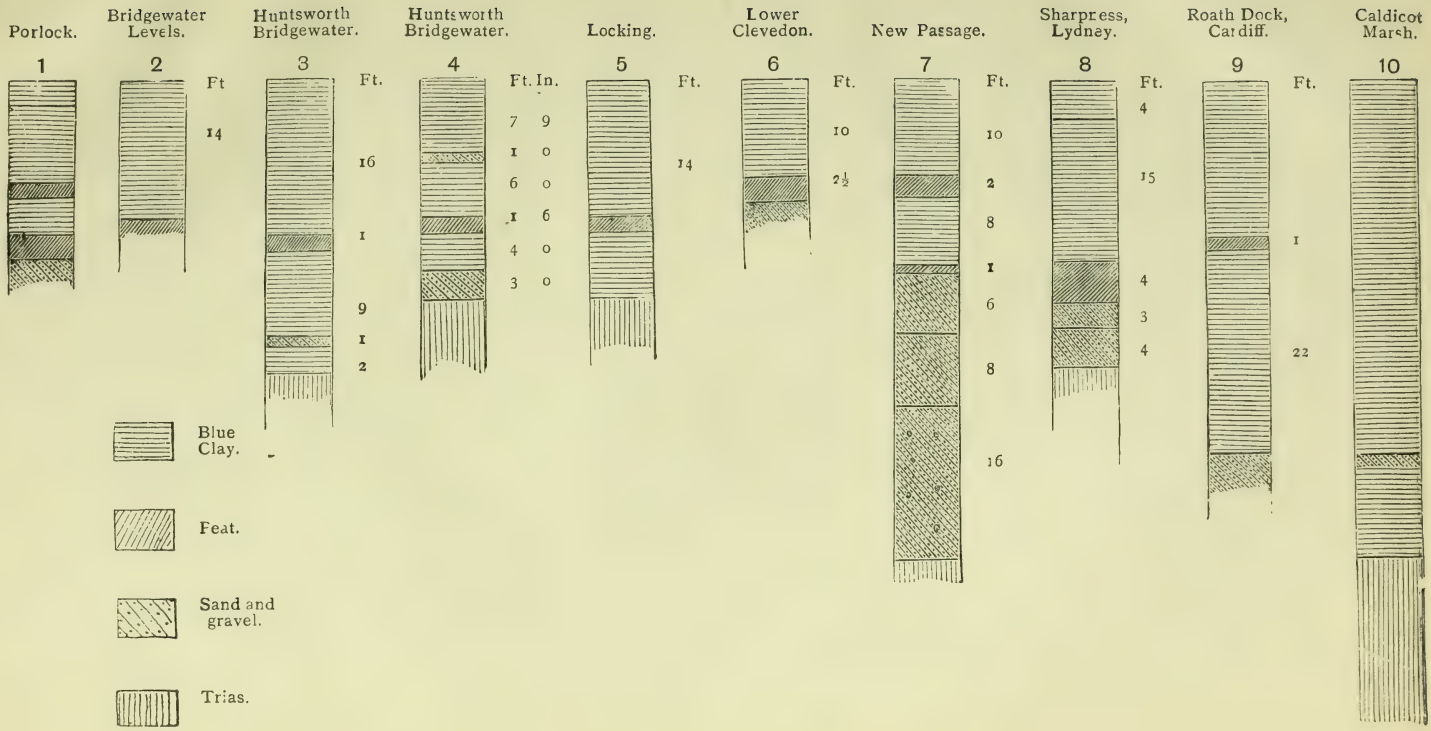

BARRY ISLAND & NEIGHBOURHOOD.
from the Six-Inch Ordnance Maps
published in 1885.
The Barry Docks, Sea Walls, etc. have been added from a map by Mr James Bell (1893).
Outcrops of solid rock between tide-marks shewn thus
Scale: 2 Inches to the Mile.
Cadoxton Moors
CADOXTON RIVER
Sully Moors
Mill Cottage
Hayes Farm
B.M.
Previous
19

SECTION THROUGH EAST DOCK, BARRY.




Porlock.
1
Bridgewater Levels.
2
Ft
14
Huntsworth Bridgewater.
3
Ft.
16
1
9
1
2
Huntsworth Bridgewater.
4
Ft. In.
7 9
1 0
6 0
1 6
4 0
3 0
Locking.
5
Ft.
14
Lower Clevedon.
6
Ft.
10
2½
New Passage.
7
Ft.
10
2
8
1
6
8
16
Sharpness, Lydney.
8
Ft.
4
15
4
3
4
Roath Dock, Cardiff.
9
Ft.
1
22
Caldicot Marsh.
10
Blue Clay.
Peat.
Sand and gravel.
Trias.

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The Geology of the East Barry Dock, with Notes on the supposed Coalfields of South Glamorgan.

By F. T. HOWARD.

(With an Appendix on the Fauna and Flora, by F. W. Wotton).

IN my paper on the Geology of Barry Island (Cardiff Nat. Soc. Trans., vol. XXVII., part 1, p. 42) I pointed out that the island was in no wise distinct in its geological character from the mainland, but that all the beds there exposed could be found on the opposite shore of the old river channel.

I propose in the present paper to give an account of the later deposits of the district, and to discuss the probable date of the separation of the island from the mainland.

The facts relating to these beds which I am bringing before your notice would have remained almost unknown if the docks at Barry had never been constructed. To Mr. Storrie I must, in the first place, acknowledge my indebtedness, especially for information respecting the western or main dock. It has also been my privilege to accompany Mr. A. Strahan, of the Geological Survey, on several occasions. The results of his investigations will appear in the Quarterly Journal of the Geological Society (vol. LII., No. 207), as well as in the Survey Memoir on the district.

In the previous paper I indicated the various outlets of the Cadoxton River, and many present will remember that at the time when the first dock was commenced the main outlet was between the Yorke Rock and Coldknap, and that behind the island stretched a muddy flat, which broadened out near the old mill, and at high tide was flooded by the sea entering between the Bendrick Rock and the island. To the

south the elevated portions of the island, the Mark Rock and the Bendrick Rock, afforded a protection from the strong currents of the Channel.

The new dock is situated entirely on this tidal flat, with the exception of a small portion on the east side near Warren Tump (now levelled), and another on the south near the Coston Rock. The greater part of the excavations were in the soft alluvial deposits, and the following section is fairly typical :—

1. Blown sand.
2. Clay with marine shells, particularly *Scrobicularia*.
3. Sand and gravel with marine shells.
   A well-marked line of erosion.
4. Blue silt with plant remains.
5. Upper peat bed.
6. Blue clay.
7. Thin peat bed.
8. Blue clay.
9. Peat bed with many logs and roots of trees.
10. Blue clay with plant remains and shells.
11. Peat bed with land shells, trunks and logs of trees.
12. An old soil with roots, land shells, etc.

1. The sand, like that on the island, seems to have been brought entirely by the wind, and has accumulated in the main on the east side in the neighbourhood of Warren Tump. Land shells are very numerous, particularly *Helix virgata*.

2. The clay, which occurs below the sand and at the surface when that deposit is absent, varies in colour from red to dark brown, and dries into a hard mass with prominent vertical joints. I well remember an uncomfortable walk across the clay after the pumping operations had commenced, in order that I might see what deposits were under formation. Near the Trias Rocks of Warren Tump there was little or no clay, but an angular gravel derived from the rocks close by. Between this point and the old river course, particularly towards the north, the clay thickened, and in some cases I noted a depth of about nine feet.

Almost everywhere such marine shells as are common to-day in the neighbourhood of Barry can be picked out from the clay, though no species is so well represented as *Scrobicularia plana*, with its double valves in position, indicating that the shell had not been rolled much after the death of its occupant.

3. Beneath the clay, and really forming part of the same bed, lies a bed of gravel, or rather loose shingle, derived in the main from the earthy sandstones and limestones of the Trias of the neighbourhood. It varies greatly both in thickness and in character. Here it is composed of layers of coarse and fine gravel; there a number of bands of fine sand are intercalated. Sometimes it is distinctly divided from the clay above; sometimes there is a gradual passage from one to the other. The thickness usually varies from two to eight feet, and in a few cases the clay was noted to lie directly on beds older than the gravel.

The shells are similar in character to those in the bed above, but are generally in a rolled and broken condition, though many united valves were clustered together around rocks which projected from the surface of the Trias immediately beneath the gravel on the east side of the dock. Drift wood was also fairly abundant near the old river course in the gravel.

The base of the whole marine series is very readily observed by a well-marked line of erosion. As has just been stated, the gravel succeeds the Trias on the east side, but elsewhere it lies on the blue alluvial clay, and on the west side of the dock is in contact with the upper peat bed (5).

The clay and gravel are plainly of marine origin, as attested by the character of the shells, and are perfectly distinct from the beds below. These as a whole are of an estuarine type, with an occasional land surface indicated by the plant growth.

For several reasons it was important to ascertain the depth of the peat beds from the surface, and I have to thank one of my former students, Mr. Hugh Davies, for surveying the ground. From his measurements we calculated that the top of the

Upper Peat Bed	(No. 5)	was	3—4	feet	below	Ordnance datum.
Second „	(No. 7)	„	9—10	„	„	„ „
Third „	(No. 9)	„	16—17	„	„	„ „
Fourth „	(No. 11)	„	32—33	„	„	„ „

For the sake of comparison I obtained the following data from the engineer in charge.

	Feet reckoned from Ordnance datum.
Level of quay—coping round dock	26·50
High water ordinary spring tide	19·70
High water ordinary neap tide	11·30
Mean sea level at Barry	1·60
Low water ordinary neap tide	− 8·3
Low water ordinary spring tide	−16·4
Bottom of dock	−20·0

The blue silt is of very similar character from top to bottom. No. 4 —the upper layer—is thickest on the east and south, occasionally measuring over 6 feet; but on the west side—that is, nearer to the course of the old stream—it was gradually cut out by the tide, and the marine deposits repose directly on the peat below. The clay itself slightly overlaps the underlying peat, and lies directly on the Trias in places. Plants in the position of life are abundant, and we obtained foraminifera from the lower zone, proving that the area was not at the period of formation entirely shut in from the sea.

5. The most distinct bed of the whole series is the Upper Peat Bed. The black line with a lighter band in the middle, stands out very distinctly from the bluish grey silt, and afforded (as did the other peat

beds) an easy line of division for the workmen in removing the stiff clay when constructing the dock.

It is divisible into—

(a) Thin peat with logs.
(b) Ostracod or Gutta-percha Marl.
**(c)* Shell Marl.
(d) Peat with many logs.

(*b*) The Gutta-percha Marl is of a light-grey colour, and, as the name suggests, is very flexible when fresh and damp, though it loses this character when dried. It is almost entirely made up of the minute valves of Ostracod Crustacea with a varying proportion of vegetable matter. In one place—in the middle of the dock—I found a large number of nutshells in this bed. It is rarely more than four inches thick, and is best developed in the south-east and centre of the dock. Near Warren Tump and the Coston Rock the bed disappeared, and I failed to find it near the old course of the Cadoxton River.

(*c*) The Shell bed is crowded with Gasteropods — particularly *Limnæa* and *Bythinia*—and Ostracods are also numerous on this horizon. They are all set in a matrix of vegetable matter. The usual thickness is about six inches. The bed is more persistent than the Gutta-percha Marl, though it disappears near the margins where the older beds rise into view, as well as near the former river course.

(d) The peat below contains a large number of logs and stumps of trees, particularly of the oak. They appear to be most numerous where the peat rises on to the Trias—along what was formerly the margin of the swamp. † It is from this bed that Mr. Storrie obtained a worked flint of Neolithic age (also a skull and two bone needles in the first dock).

I also found bones and antlers of *Cervus elaphus*.

6. A blue clay of similar character to No. 4, varying from five to seven feet in thickness. On the east side of the dock it is rapidly thinning.

7. This peat bed is nothing more than a black line of a few inches in thickness, without any proper definition, and it is not persistent throughout. It seems to indicate a stage when the supply of vegetable matter was larger than usual. I found several snail shells in this bed.

8. In this silt the upright stems of sedges are very noticeable, and I obtained a fair number of fresh-water and land shells from it. Otherwise it is similar to Nos. 4 and 6. The bed varies in thickness from five to eight feet.

9. The third Peat Bed is more persistent than the one above it, and occasionally reaches a thickness of one foot. This peat bed, more than any other, is made up of twigs, logs and trunks of trees, and

* Occasionally a thin peat separates the Gutta-percha Marl from the Shell Marl.

† The Cardiff Museum has lately acquired a perfect flint celt 6 inches long, tapering and oval in section. This was found on the surface of a peat bed over 3½ feet thick, occurring below 14 feet of soil and alluvial clay, during the excavations for the Dowlais Works, Cardiff. It was associated with bones of *Cervus elaphus*, and of a bird, probably *Cygnus* as well as large trunks of the oak, alder, and willow. The peat beds are most likely of the same age.

the evidence of the surface beneath in places favoured the idea that some at least of the stumps discovered were in the position of growth.

The cuttings had laid bare the peat lying directly on the Trias bed, and overlapped by the beds already described. In the same way the peat was seen to overlap on to the Carboniferous rocks where the south dock wall has been built, though it had disappeared on the east side where the Trias was exposed.

The information respecting the remaining beds is not so complete, and depends on the borings made previous to the excavation of the dock and on the sections exposed in the cuttings for the foundations of the dock walls.

10. A blue silt very similar to the higher beds, containing foraminifera towards the top and many plant remains, and land shells in the lower zones.

*11. This Peat Bed is thicker than the others, rising occasionally to 3½ feet. Many logs of trees were seen in this bed.

12. Directly beneath the peat was an unstratified deposit containing blocks and fragments of the rock below, and with rootlets running in every direction, suggesting that the bed is an old land surface.

The interpretation of these facts, and the explanation of the actual mode of formation of each bed must depend largely on the plants and animals contained in them. In the appendix is given a fairly complete list, gathered from the researches of Messrs. Harris, Storrie, Wotton, and others.

Commencing at the bottom, it is plain that the lowest bed is an old surface soil, containing a large number of land shells, and of plants which would not live in places where the sea had even occasional access. The peat represents the forest growth in which the oak largely predominated, and we have evidence that in flood-time, at least, the surface was under water, a number of typical fresh-water shells being distributed over the surface.

The blue silt (No. 10) might well be a deposit formed under water which was fresh at first (as indicated by the number of shells), though occasionally affected by the tide (if *Hydrobia ventrosa* be regarded as a typical brackish water species). Foraminifera occur in greater numbers higher in the series, as if the water was becoming more decidedly brackish. The number of erect reeds and sedges suggest that the water was never very deep, and generally thick set with vegetable growth.

The peat above (No. 9) in one section clearly indicated a land growth, but this was near the edge of the alluvial flat, and though the bed continued in every direction except the north, the amount of timber was never great, and in all probability it was entirely drifted.

*At the Biglis Waterworks a peat bed, 3 feet in thickness, was proved below 3 feet of estuarine clay. The surface of the ground, however, was 23·8 feet above Ordnance datum. A thin estuarine clay separated the peat from the hard clay of the Trias below. Though relatively higher than any of the beds in the dock, the peat has many points of similarity to No. 11.

The blue silt (No. 8) must have been deposited in water more open to the tides. Though there are abundant erect stems of a sedge, the shells are a mixture of fresh and brackish water forms.

The thin impersistent peat (No. 7) merely arose from drifted sedges and other plants which were growing close by.

The blue clay (No. 6), like No. 8, was deposited in an estuary open to the tides.

The Upper Peat Bed (No. 5) confirms the idea which the lower series suggests,—that the area was gradually coming more and more under the action of the sea. Near the margins of the swamp the peat is largely composed of timber, and the oaks may have grown there as before, and have drifted thence into the swamp.

The shell bed, though extremely rich in specimens, does not exhibit a wide range of species, and none of them can be said to be charac teristic of fresh water. The typical Ostracod of this horizon *Cytheridea torosa* is also a form living in brackish water to-day.

The blue silt (No. 4) above contains shells of the same type, while the gravel indicates that a much larger volume of salt water had entered the area.

We have two problems still before us :—Do the peat beds really indicate a subsidence of the surface in late times near Barry, or is it possible to explain their presence in any other way?

Secondly, can we determine at what period and in what manner the island was separated from the mainland?

It may be of some assistance to us in considering the first question to have the evidence of movements of the surface in recent times in other places. The accompanying illustration, reproduced by the kind permission of Professor Sollas, will show the position of the peat beds in various sections.

At Porlock the shingle and silt with *Scrobicularia* succeeds a peat largely made up of the yellow iris, which is separated by a fresh-water silt from the lower peat—an old forest growth, principally composed of the oak, alder, yew and Scotch fir. Many Neolithic flint chips and flakes were obtained by Professor Boyd Dawkins from this horizon between Porlock and Minehead, together with bones of the ox, goat, sheep and pig.

At Locking the peat consisted of yellow flags, fungi, trunks of the oak, fir, beech, &c.

At Lydney the peat included some very large trunks of the oak, alder, beech, and hazel.

The section at Cardiff Roath Dock, as examined by Mr. Storrie, was as follows :—

	ft.	in.
Estuarine silt with abundance of foraminifera	5	6
Peat composed of reeds	0	3
Clay containing foraminifera partially pyritized, also a chain and a human jaw	0	2½
Peat composed of reeds	0	2½
Estuarine silt, surface penetrated by roots containing *Scrobicularia* in abundance, pyritized foraminifera, several species of *Helix*, and towards the bottom, trunks of the oak and willow ...	7	6

	ft.	in.
Peat composed of reeds, principally *Sparganium*	0	9
Clay with foraminifera, much pyritized, and trunks of the willow ...	2	0
Peat composed of reeds	0	3
Silt	1	0
Gravel principally derived from Pennant Grit, with a smaller number from the Millstone Grit and Old Red Sandstone	12	0
Trias	0	0

Moggridge also described the sections exposed during the construction of the Swansea docks, where *Scrobicularia* clays alternate with beds of peat.

Further west tradition supports the idea of a great extension of land in St. Bride's Bay and in Cardigan Bay. The tradition, it is true, lays the charge of the inundation to the negligence of a drunken man who neglected to close the sluice gates and so ruined the inhabitants of the Cantref-y-Gwaelod.

It is well ascertained that the coast in Roman times was much as it is now—certainly a large bay existed in West Wales. It would require an immense barrier of at least 30 miles in length and of enormous strength to withstand the ravages of the storms during the prevalence of the S.W. gales.

The so-called roadways, such as Sarn Cynfelin, running outwards are, in all probability, judging by their character near the coast, only banks of boulders and pebbles accumulated by the strong tidal currents of the Bay.

We can well believe that the Lowland Hundred was a rich and fertile plain as compared with the more barren hill country behind, and that it was peopled by the Neolithic folk until the gradual subsidence affecting the whole of Britain allowed an inrush of the sea over 35,000 acres of land. The loss of their fair country would be handed down as a tradition, and has been in later times exaggerated and personified in the story now commonly accepted.

In the same way, the story that the inhabitants of Gower in former times drove their cattle across Swansea Bay to Bristol market refers to the period when the bay was a low-lying plain. We can scarcely imagine that Bristol possessed a cattle market in Neolithic times.

Geraldus Cambrensis tells us that during the visit of King Henry the Second to Ireland, a violent storm laid bare the trunks of trees in Newgale Sands, which were black as ebony and preserving the marks of the hatchet. Dr. Hicks recorded the fact that in 1866 they were again laid bare, and he saw the roots firmly fixed in the boulder clay below, and obtained from the peat many antlers of the red deer, a jaw of the brown bear, and a flint flake.

Though not absolutely conclusive, the evidence strongly suggests a general subsidence affecting the whole of the Bristol Channel.

I have previously put forward the suggestion that the Cadoxton River originally crossed Cold Knap, and ran out to the sea on the west side until the entrance was blocked up by the storm beach. Is it possible that in this way the original river valley was cut off and protected from

the sea and converted into a marsh? We must also remember, in considering this point, that a very large area near the Channel would be liable to be flooded by exceedingly high tides if artificial means were not taken to prevent it. There is historic evidence that Cardiff itself, and the whole of the East Moors, Wentloog and Caldicott levels were under water in the year 1607 A.D., and it is scarcely likely that the Sully Moors, which are, on the average, lower than the East Moors, Cardiff, would escape the same tidal action.*

If the outlet of the river was blocked in the manner suggested, and all the other means of entrance of salt water closed, we should expect the area to become a large fresh-water lake. But even if this was once the true state of affairs, we have still to meet the difficulty of a soil and forest growth (with all traces of the contemporaneous action of salt water absent) now occurring at a depth of 36 feet below Ordnance datum. Such a bed could not be formed at the bottom even of a fresh-water lake.

We seem to be driven to the following conclusion :—

That since a height of 18 feet above sea-level is not sufficient to escape very high tides to-day, the old forest, now buried 36 feet below sea-level, must have flourished when the ground was at least 54 feet higher than it is at the present time.

Our conclusion is confirmed when we look at the whole evidence broadly. The whole of the flat between Barry, Cadoxton and Sully at first was one large swamp, for the most part densely covered with sedges, though here and there sufficiently protected from the stream to support a rich forest growth. Then the land sank, and became, to a certain extent, a shallow fresh-water lake. On the banks occasionally we might have seen herds of wild cattle and of the red deer in rapid flight, pursued by the half-clad, short-legged Iberians of the island. Or the eye might have followed a wolf or a grizzly bear noiselessly creeping from his home in the limestone cliff of Bendrick or Sully and waiting his opportunity to spring on his unwary prey. From the lake itself the heron would rise on heavy wing, or we might have heard the noisy splashing of the ducks disturbed by the herdsman tending his flocks in the clearings of the forest.

A further subsidence caused the water to become brackish through the influence of the tide—at first only temporarily, but later more permanently, until a new channel was opened, whereby a strong current entered the swamp, introducing a typical marine fauna, and partly destroying the material which had already been deposited, and covering the whole with a mixture of material worn from the rocky shoals of the neighbourhood.

The evidence seems to point to the Channel between the Bendrick Rock and the island as the one which, when opened, gave rise to so marked a change in the deposits. As to the period of opening, the only data from which to reckon are the remains found in the peat beds

* October, 1896. Recent events have added much to our knowledge of this particular aspect of the question.

—the Neolithic worked flint and the human skull and bone needles of the first formed dock. We may safely assume that when Neolithic man had his home on Barry Island (as the recent excavations of Mr. Storrie have conclusively proved he had) the island was connected to the mainland near the Mark Rock.

I have already mentioned that the alluvial deposits on the north and east gradually overlapped on to the Trias, which were fully exposed, from the Dolomitic Breccia at the base through the red clay to the tea-green marls and limestones, during the excavations. These were succeeded in Warren Tump by beds of Rhætic age, thrown down by the same fault, which was traced from Cold Knap across the island. The throw appeared to have much diminished, and several small reversed faults were noted on the north side of it, both in the dock and Warren Tump itself.

The most interesting section, however, is at the Coston Rock, where the south wall of the dock has been built. Here the Carboniferous limestone rises very steeply, and the lower alluvial beds end against it, while the upper peat bed and the clays accompanying it overlap, and are found above the limestone.

The section as exposed is given below :—

		feet.	inches.
Marine Series	Red Clay (No 2)	1	0
	Scrobicularia gravel (No. 3) ...	6	6
Alluvial Deposits	Blue silt (No. 4)	3	6
	Peat with some shells (No. 5) ...	0	8
	Blue clay (No. 6)	3	6
Carboniferous.	Conglomerate	7	0
	Red earthy limestone with green patches	5	0
	Red and green clay with bands of sandstone	3	0

The conglomerate is really an impure limestone containing pebbles of white vein quartz. At first, I was disposed to place it with the Trias, and Mr. T. H. Thomas mentions, on the authority of Mr. Storrie (Brit : Ass : Guide to Cardiff, 1891), the occurrence of "a form (of *Dolomitic Breccia*) near Sully, where white quartz pebbles take the place of the angular fragments of limestone."

I failed to find any evidence of unconformity, so have grouped it as part of the Carboniferous series.*

The limestone below is very impure, and occasionally shows distinct quartz grains, some of which by segregation have assumed crystallized forms. Here and there it is oolitic, and is much veined with calcite, which probably, like the slicken siding, is due to the same force which produced the fault close by.

One variety of the rock (possibly a fault rock) was stained green, though red was the predominant colour of the strata.

The red marl below seemed to be of the same character as the Old Red Clay, though the section was not clear enough to enable one to say whether or not it was merely a band in the limestone.

* October, 1896. Since that time I have noted a conglomerate in the base of the Carboniferous limestone at Wentwood.

The limestone was again seen in the south-east corner of the dock, dipping 15°—20° north, and consisting of thinly bedded, very impure, and encrinital limestones. The dip is evidently irregular, for in a hole directly south of the wall, and not more than 30 yards away, it rose to 25°, then 40° north, and slightly to the west it was 15°—25° N. by W. It is probable that this is due to the fault already mentioned. In this hole the Old Red Beds rise from beneath the Carboniferous. (The section was given in my former paper.)

So far we have been dealing with beds on the north side of the anticline. Further to the east the limestone reappears from beneath the Trias limestones and breccias, through which the latest course of the Cadoxton River has been cut.

In the cliff, about 700 yards west of Hayes Point (by "High" of High Water Mark on map) it is unconformably succeeded by the Dolomitic Breccia and red Trias clay. The limestone itself is extremely rich in remains of encrinites, and varies in colour from red to grey. It is strongly jointed, and the fissures are often filled with hæmatite (more rarely limonite) with its characteristic mammillated structure. The lower beds on the shore include siliceous limestones and bands of red and black shale. A small fault, throwing about 9 feet to the east, causes some irregularity in the dip, but on the average it is about 15° N.W. To the east the breccia stretches sharply over the edges of the limestone, and comes down to the level of the foreshore, thus concealing all traces of the Carboniferous beds until we reach Sully.

The limestone exposed at the Bendrick and Mark Rocks is greyish in colour, and as a whole siliceous though the weathering indicates much variation in hardness. Chert bands are fairly numerous. Crystals of pearlspar, galena and barytocelestine were noted together with well-developed dendritic markings. The dip is 50° SS.E.

The distance between the coast section and the Bendrick Rock is so small that one might be tempted to introduce an east—west fault to account for the remarkable differences of dip. But the section from the Coston Rock to the Mark Rock showed an ordinary anticline, and the continuation of this would be sufficient explanation in this case.

The exposure at Sully Island showed a similar unconformity of Trias overlying Carboniferous limestone, here dipping 45°—50° E. by N., and rising almost vertical to the west near a fault which crosses the island about the centre, throwing about 13½ feet east. The Trias occupies the greater part of the surface, and it is in these beds that the channel dividing the island from the mainland has been worn out. Another fault, nearly parallel, is seen near Ball Cottage, and immediately to the north a sharp rise indicates another mass of the Carboniferous limestone. The average dip is here 50° S.E.—SS.E. Quarries occur, though few are in use, along the ridge westwards as far as the Taff Vale (Cadoxton Branch) Railway which has cut through the beds of the Trias and exposed the limestone below. The limestone is red, hard and crystalline, and exhibited in one or two bands oolitic structure. The dip is roughly 38° S.W.

The limestone is again strongly developed at Cadoxton. The railway station is unmistakably on New Red Marl, but in the main road the Dolomitic Breccia appears below, and in the short distance between the station and the Wenvoe Arms both marl and breccia disappear and the Carboniferous limestone again comes to the surface. Quarries exist on every side, but the best section runs along the Barry-Pontypridd line. A large quarry has been opened near the junction of the Barry and Taff Vale lines, which has laid bare the red marl and breccia and the Carboniferous below. The latter consists of hard crystalline limestones, usually stained red, and containing many encrinites, together with thin shale bands. The dip is here 27° N.W. or N.W. by W., but as the section is followed north it rises until at the end it is over 60°. Owing to the rapid development of Cadoxton there are innumerable road sections and quarries. The dips are scarcely as regular as I expected. The high dip of 60°—65° N. or N.W. seems to be the average on the northern face where it is overlapped by the Dolomitic Breccia. It extends only a short distance north of the stream except at one projecting point in Robbin's Lane.

A large quarry near the old church shows one thick band at least of black shale. There seem to have been a number of small strike faults or gliding planes whose hade almost coincides with the high dip, and in consequence the thickness of the limestone appears greater than it is in reality. A number of sections along a line showed puzzling planes of division at an angle varying from 55°—80° SS.W. I believe that they must represent jointing and not dip-planes, for to the south below the Board School the dip is plainly 60° N. by W., and in Court Road at junction with Norwich Road 65° north. Further to the south the Dolomitic Breccia begins to appear above the limestone whose dip flattens, and on the northern bank of a small stream near the Rectory it is only 22°—30° N.—NN.W. Along the brook there appears to be a roll, for the dip shifts westerly ; then on the south side of the brook, and in several quarries in Beatrice and Charlotte Streets, leading out of Weston Hill, it is 20°—25° S.W.—S. Unfortunately the limestone is covered to the south and west by the Trias so that it is impossible to say whether the south dip is local (possibly due to a fault) or whether it is general and persistent. If you will recall the fact that the dip of the limestone at the Coston Rock and on the shore to the east is in a north direction you will see the importance of such evidence, for if there is a syncline under the dock, it is more than probable that it is also a small coalfield.

From a comparison of the beds I am led to believe that nearly the whole of the limestone is exposed at Cadoxton, and that the upper limit occurs not far north of the church. But here again our evidence is abruptly interrupted by the overlap of the Trias. It is plainly not merely a thin surface bed, for at the brickyard, N.E. of the church, the red clay has been worked to a depth of 50 feet. The quantity of water springing up suggests that the breccia is not far below.

If we look northwards from Cadoxton, we can trace with ease the sharp rise along the outcrop of the Carboniferous beds from near Dinas Powys westwards past Wenvoe in the direction of Peterstone and Cowbridge. At Dinas Powys station the Dolomitic Breccia is strongly developed; but to the west, near the cross roads by Westra Farm, a large quarry shows the limestone beneath the breccia. Where the road immediately strikes the foot of the cliff a small quarry has been opened, and the dip appears to be 10°—15° north, but an obscure exposure in the road 200—250 yards east of S. Andrew's Church shows a S.E. dip. At Pentwyn Cottage, north of St. Andrew's Church, hard siliceous limestones crop out with a dip of 55°—60° S. by W.—S.WW. Following the same road westwards the limestone may be again examined in the cutting of the Barry Railway and in a small quarry above, where the dip is 10°—15° S.W.—W.S.W. The rock shows perfect oolitic structure. It is again covered to the north by the breccia. The irregularity of the dip is probably due to a fault.

On the average the dip may be said to be in a S. or SS.W. direction.

The limestone reappears from beneath the Trias near Burdonshill and an old pit represents an abortive attempt to work the thin galena veins there. Along the same line, nearer Cowbridge, lead has been worked successfully in the past from the same horizon. The dip of the limestone there also retains its southerly direction.

I have mentioned a number of details which to many must have been dry and uninteresting. My reason for so doing is to lay before you the data on which De la Beche concluded that a coalfield existed hidden beneath the newer beds of the Vale of Glamorgan (see Memoir of the Geological Survey, vol. I, Horizontal Section).

You must remember that in these matters, where we can only pick up odd fragments of information, we must only speak of possibilities.

The presence of a large fault—a small fold or a greater amount of denudation than expected, would nullify all our conclusions.

Let me recapitulate the leading points :—

(1) The existence of what I may term the Barry Island-Bendrick Rock anticline.

(2) The northerly dip of the limestone at the Coston Rock, and in the cliff to the east.

(3) The southerly dip of the limestone near Cadoxton Vicarage on Weston Hill.

(4) The main northerly dip of the Cadoxton mass of limestone.

(5) The southerly dip of the Cowbridge, Peterstone and Wenvoe exposure of limestone.

The dip at the Coston Rock was swinging round, and both here and to the east the ground is faulted, so that it would not be safe to conclude anything without further evidence. In the same way the dip on Weston Hill is to the south, but the overlap of the Trias gives no opportunity to prove if it is local or general. My own impression is that both are only local rolls, and that, even if the

Carboniferous beds were ever reached below Barry Dock, the Coal measures would be entirely unrepresented.

Not so, however, to the north. If we have, as I believe, the whole of the limestone exposed at Cadoxton, the Millstone Grit would not be more than a few hundred feet at most in thickness, and the high dip would reduce the outcrop to a mere nothing. The Coal measures should, if we could see them, crop out before we reach Mr. Arkell's brickyard, N.E. of the Church. It is difficult to point out the northern limit of the coal basin, owing to the changeable dip of the limestone of the Cowbridge-Wenvoe exposure. It certainly lies south of a line drawn east and west through St. Andrew's village. To the east I should expect to find little or no representatives of Coal measures, for an anticline crossing the other folds along a line NN.E.—SS.W. brings up older beds, as seen in the Silurian exposure near Cardiff, and in that of the Carboniferous near Cog and Lavernock.

To the west it is quite possible that the beds may extend both in breadth and thickness.

The next question is as to the depth of the presumed coal seams. The only fact bearing on this is the depth of the clay at Mr. Arkell's brickyard, which at least is 50 feet. Though one must not connect the two of necessity, it may be interesting to note that at the Cardiff Docks the same clay reaches a thickness of 400 feet. In addition to this, very frequently, there are beds of Rhætic and Lias age above the Trias in South Glamorgan. There is nothing apart from actual boring which can settle this point.

Of the seams which we expect to find it is plain that those near the base of the Coal measures are the most likely to occur. These include many seams of well-known quality, occurring fairly close together.

Granted that the coalfield exists, the steep dip which prevails leads me to suppose that the difficulties of working would be great—quite as much so as on the southern outcrop of the main coalfield.

Though I can scarcely expect that any venturous spirit will in the near future explore the Cadoxton-Wenvoe coalfield, I hope that I have not wearied you too much in giving you the reasons for presuming its existence.

N.B.—The illustrations are reproduced by the kind permission of the Council of the Geological Society and of the authors of the papers—Mr. A. Strahan and Professor Sollas.

Appendix.

By F. W. WOTTON.

THE material from the shell bed deposits on the site of the new Barry Docks has furnished many species of shells. The quantity of such deposit examined was naturally small; had a much larger lot been gone through other species would in all probability have been found.

The fossils indicate that the land has in turn been occupied by Fresh Water, Brackish Marshes, and the Sea, and they silently record the changes that have taken place in the struggle for predominance between sea and land.

The shells and plants are recorded from each bed numbered in the same way as in the preceding paper.

1. Surface sand containing bleached shells of *Helix virgata.*

Also from a lower zone—

Limnaea peregra
Bythinia tentaculata
Planorbis nautileus
,, ,, var. cristata

Judging from the thinness of the shells and their general appearance they were evidently carried down by a running stream, probably the Cadoxton Brook. Running water generally produces thin, clear shells, whilst those found in stagnant pools, etc., are thicker, more opaque and solid.

No. 2 and 3. Marine Bed.

Littorina littorea
,, ,, var. acuminata
,, rudis
,, ,, ar. tenebrosa
,, obtusata
Patella vulgata
Buccinum undatum
Purpura lapillus
Trochus umbilicatus
Utriculus obtusus, in all stages of growth
Tellina balthica
Scrobicularia piperata
Kellia suborbicularia
Cardium edule

Most of the Univalves were beach-rolled and chipped with the exception of *Utriculus.* This shell was embedded in the clay, and came out in good condition.

L. rudis var. tenebrosa is an estuarine form and has been found living in brackish marshes associated with the *Hydrobiae*. The small thin-shelled variety of *Tellina balthica* found, is also an estuarine form. It still lives in the Bristol Channel, and I have seen thousands of them alive on the mud near the East Dock, Cardiff, thrown up after a storm.

All the species may still be taken alive between the tide-marks on the Glamorganshire coast.

No. 4. Clay—

Cytheridea torosa var. teres
Loxoconcha elliptica — Ostracod Crustacea
Trochammina inflata
,, ,, var. macrescens
Rotalia Beccarii (small)
Nonionina depressula — Foraminifera
Polystomella striatopunctata
Scirpus maritimus (a sedge)

No. 5. (*b*)—

Limnaea auricularia
Limnaea truncatula
Valvata piscinalis
Many Opercula of Bythinia
Candona pubescens
,, subaequalis
,, candida
,, lactea — Ostracod Crustacea
Darwinula Stevensoni
Limnicythere inopinata
Cytheridea torosa, var. teres

Lagena globosa
,, laevis
Discorbina rosacea
,, obtusa — Foraminifera
Rotalia Beccarii
Polystomella striato-punctata
Dendrophora erecta
Elytra and legs of a fresh-water beetle, Acilius (?)
Fish scales in bits
Campylodiscus, a Diatom
Nucules and fragments of the stem of Chara

No. 5. (*c*) Shell marl—

Succinea elegans
Velletia lacustris
Limnaea auricularia
Limnaea peregra
,, ,, var. maritima
,, ,, var. ovata
,, ,, var. labrosa, 1 only
Valvata cristata
,, piscinalis
Planorbis nitidus
,, nautileus
,, albus
Bythinia tentaculata
Pisidium fontinale
,, pusillum

Hydrobiae ulvae, few
,, ventrosa, numerous
Ostracod Crustacea
Foraminifera — as in 5 (*b*)
Diatomaceae

Fish scales fragmentary, small vertebrae and a tooth, apparently of the Roach.

Rumex crispus (dock)
Atriplex
Salix (willow)
Potamogeton
*Naias marina — pond weeds
Chara, 2 species
*Pinus

The *Pisidea* were in good condition with the valves together. The *Hydrobiae* are purely brackish water molluscs. Both species could be taken somewhat plentifully on the East Moors and Grangetown Moors a few years ago on ground now covered by buildings. *Hydrobiae ulvae* may be found under stones at Penarth in the littoral zone. *Limnaea peregra var. maritima* is also a brackish water variety. It used to occur on the East Moor where the Dowlais Works now stand. I am

* Not known in Wales in historic period.

inclined to the belief that this deposit was formed on a marsh affected by the high tides as indicated by the presence of the *Hydrobiae*, etc. The other species may have been conveyed into the marsh by a stream, or more probably, lived in it before it became within reach of the tides. The Foraminifera are entirely of marine origin, but their presence may be accounted for in the following way :—After the death of the animal the tests float on the surface for some time before sinking and might easily be carried inwards by the tide. The total absence of marine shells is easily explained, for, being heavy, they would only be rolled along at the bottom of the water, and would be kept out of the marsh by any obstacle such as a sand barrier.

No. 5. (*d*) Peat—

Quercus robur (Oak), trunks, branches and stumps
Corylus avellana (Hazel), nuts
Crataegus oxyacantha (Hawthorn), stumps
Antlers and bones of Cervus elaphus
A Neolithic worked flint

No. 7 & 8. A thin peat overlying a blue clay—

Scirpus maritimus (a sedge)
Melampus myosotis
Helix arbustorum
Pupa
Hydrobia ventrosa
} in and directly beneath the peat.

No. 9. Peat—

Elytra of beetle
Scirpus maritimus (sedge)
Salix capraea (Sallow), twigs and leaves
Quercus robur (Oak), logs, stumps and roots
Corylus avellana (Hazel), twigs and wood
Coniferous wood and roots
Valeriana officinalis (Valerian), seeds
Carex (a sedge), seeds

No. 10.—

Limnaea auricularia
Planorbis nautileus
,, albus
Valvata cristata
,, piscinalis
Hydrobia ventrosa
Cythere pellucida } Ostracod Crustacea
Cytherura producta }
Miliolina oblonga
,, subrotunda
Cornuspira involveus
Trochammina inflata
,, ,, var. macrescens
Textularia trochus
Bolivina textularioides
Lagena globosa
Polymorphina lactea
Discorbina rosacea
,, Bertheloti
,, obtusa
Truncatulina ungeriana
Rotaliá Beccarii
Nonionina depressula
Polystomella striato-punctata
Campylodiseus, a Diatom
} Foraminifera

No. 11. Peat—

Hyalinia (Zonites)
Pisidium
Planorbis shells, generally crushed
Quercus robur (Oak), wood much broken
Corylus avellana (Hazel), twigs and nuts
Cornus sanquinea (Cornel), seeds
Crataegus oxyacantha (Hawthorn), seeds
Sparganium (Bur-reed), seeds
Salix capraea (Sallow), leaves

No. 12. Old surface soil—

Charychium minimum
Succinea
Hyalinia (Zonites)
Limnaea trunculata
Valvata piscinalis
Cardium edule, fragments, possibly dropped by birds
Pupa
Helix arbustorum
,, rotundata
,, hispida
Quercus robur (Oak), wood and roots
Crataegus oxyacantha (Hawthorn), seed
Cornus saqnulnea (Cornel), seeds

All the fresh-water shells are recent species and their descendants still inhabit the ponds, streams, etc., of Glamorganshire. From this fact it is evident that the conditions of life—climatic and otherwise—that exist now prevailed during the whole of the time in which these beds were laid down, consequently a very remote antiquity cannot be assigned them. It is probable that they belong to the late Neolithic age.

Ladies' Day.

Wednesday, 1st July, 1896.

By C. T. WHITMELL.

SOON after 9 a.m., Members and their friends, to the number of fifty, left Cardiff Station in specially-reserved carriages for Pilning, and thence proceeded in brakes to Aust, the eastern terminus of the Old Passage. The name Aust is said to be a corruption of Augustus, and the place is on the line of a Roman Road. Splendid views of the Monmouthshire hills beyond the Severn Sea were here revealed.

The fine cliff section, one of great geological interest, was briefly but lucidly explained by Mr. F. T. Howard, Lecturer in Geology at the University College of South Wales and Monmouthshire.

The Rhætic strata, similar to those at Penarth, comprise tea-green marls, black shales, and white Lias. A well-known bone bed, containing remains of the fossil fish, *Ceratodus*, investigated by Agassiz, occurs here. This genus is now represented by the Barramunda, which inhabits rivers in Queensland, Australia. A curious double "Fault" was well displayed in the cliff. The President, in the name of the Society, thanked Mr. Howard for his interesting notes.

Near to the foot of the cliff is the decaying landing stage, formerly used by the ferry boats, which, in the old days, conveyed the mails and stage-coach passengers (travelling from Bristol to South Wales) from Aust to Beachley on the Chepstow side. The old Coaching-house, of very spacious dimensions and quaint appearance, is now a Farm House.

After a pleasant drive of five miles, the quaint old-world town of Thornbury was reached. Here a visit was paid to the Church. We were conducted over the building by Mr. H. H. Lloyd, who kindly pointed out the special features of the edifice.

The Church, dedicated to St. Mary, is a very noble structure, of unusual dignity and dimensions, and bearing distinct evidence of a day

when Thornbury was a place of more than local importance. The style of the building is early perpendicular, and the stately tower stands almost unrivalled, even in a district rich in architectural examples.

The resemblance, in several respects, of this building to that dedicated to St. John, at Cardiff, is very striking, and it seems not improbable that the same architect designed both churches. The Society cordially thanked Mr. Lloyd for his valuable assistance.

After lunch at the Swan Hotel, the usual business of the ordinary Annual Meeting was transacted. Mr. Robert Drane, F.L.S., nominated by the President (Canon Thompson), was unanimously elected President for the ensuing year (1896-7). In a few well-chosen words, Mr. Drane expressed his appreciation and acceptance of the office.

Whilst we were in the hotel, heavy rain fell, clearing the air and laying the dust, so that the afternoon drive of six miles to Tortworth Park was rendered all the more enjoyable.

Tortworth Court, surrounded by trim gardens, is picturesque, though modern, and the conservatories were inspected with interest. The Park contains an artificial Lake and much fine timber, including some remarkable cedars and Chilian pines, one of the latter bearing cones showing the male inflorescence. The more active members went on about a mile further, in order to see, close by Tortworth Church, the famous Spanish Chestnut Tree (58 feet in girth), the largest in England, and supposed to be 1,000 years old. It was known as a boundary mark in the reign of King Stephen, and is referred to in the time of Charles II. as a famous tree, but had then lost its top. Though most of the trunk is dead, flowers and leaves were abundant.

Magnificent views opened up from the rising ground above the Church, the Malvern Hills being clearly visible on the northern horizon. To Earl Ducie the Society is indebted for permission to visit Tortworth Park, and I have to thank his agent, Mr. Harle, for particulars about the Tree.

We drove back to Thornbury, and, at the Swan Hotel, were hospitably entertained to tea by the President, to whom a hearty vote of thanks was unanimously accorded.

After tea we assembled at Thornbury Castle, where a most interesting description of the place was given us by our courteous and competent guide, Mr. J. C. Gwynn, steward of the manor.

The Castle of Thornbury was begun by Edward, Duke of Buckingham, in 1511 (second year Henry VIII.), in which year he had license to impark 1,000 acres. In 1521, when the Castle was about half finished, he was arrested, tried for high treason, and executed on the 17th May, 1521. The Castle remained unfinished, was seized by the Crown, but restored by Queen Mary to Henry, Lord Stafford (Buckingham's son). In 1637, on the death of Henry, Lord Stafford (fifth in descent from Edward, Duke of Buckingham), it passed to his sister Mary, wife of Sir William Howard (afterwards Viscount Stafford). In 1727 it was conveyed by William, Earl or Stafford, to Edward Howard, Duke of Norfolk, who settled it on Lord Henry Thomas Howard (whose brother

in 1815 became Duke of Norfolk), Deputy Earl Marshall of England, and grandfather of Mr. Edward Stafford Howard, the present owner, who is descended from Duke Edward of Buckingham (the founder of the Castle), by the marriage of that Duke's eldest daughter, Elizabeth Stafford, to Thomas Howard, third Duke of Norfolk.

The Castle was built on the site of an old Manor House. At the first entry is the base court, about 2½ acres, surrounded by walls and buildings (now in ruin), 14ft. or 15ft. high, for the Duke's retainers. On the right is the west side of the Castle, extending 205ft., with southern tower (67ft.) complete; the northern tower and tower of the gateway were to have been of the same height, but were never finished, with the exception of the south tower and a turret; the west front rises to the height of 20ft. only. Over the gateway (west front) is the following inscription:—

"Thys gate was begon in the yere of oure Lorde Gode 1511, the 2 yere of the Reigne of Kynge Henri the viii., by me, Edward Duke of Bukkyngham, Erle of Hereford, Stafforde, and Northampton."

"The Duke's Worde,"

"Doresenavant."*

On the left of the gateway is a porter's lodge and a dungeon.

Through the gateway you enter into a Court Quadrant (half an acre), and see three sides of the Castle, the south side is complete, the other two only half finished; the fourth (east side), with private Chapel, has entirely disappeared. The south front, containing the great hall and principal rooms, is considered very fine, the windows and chimneys being very elaborate and beautiful. The carved brick chimneys are dated 1514; on the south side were the cloisters, over which was a gallery (the remains and windows of which can still be seen), leading to a room which had a window into the Parish Church, where the Duke used to hear service. The Castle Courts, buildings, and gardens are walled round, and contain within the walls 12 acres.

The three large parks, Thornbury, Marlwood, and Eastwood, made by the Duke, are now farm lands.

I may add that this Edward, Duke of Buckingham, was the son of the second Duke, Henry Stafford, executed in the reign of Richard III. He was also a descendant of the fourth and sixth sons of Edward III., and was thus regarded by many as coming next after the Princess Mary (eldest child of Henry VIII.) in claim to the Throne.

Canon Thompson, after cordially thanking Mr. Gwynn, made an apposite reference to Shakespeare's account of Buckingham in "Henry VIII." In the Play the Duke's character appears in a highly favourable light He dies, forgiving all his enemies, and praying for blessings on the King, who bears ample witness to his learning and ability.

* "Doresenavant" would now be written "Dorénavant," and means "From this time forth," or "For the future," the alleged import being that the Duke looked forward to the Crown

Seldom has the Past become more vividly the Present than when we stood surrounded by this uncompleted magnificence of ruin.

Thornbury was left at 8.30 p.m., and Patchway Station reached about an hour afterwards. The route along the elevated Ridgeway afforded charming views of the Severn, winding in the distance like "sleeping silver" through the hills.

A long wait occurred at Patchway, the train being very late. But this—the only drawback—did not mar the day's enjoyment, and a well-earned vote of thanks was passed to Mr. Cook, the Hon. Sec., for his admirable organisation of the excursion. Cardiff was reached shortly before midnight. (I have used some passages from the Day's Programme.)

By F. T. HOWARD.

THE geological features of Aust cliff are so well known that it is only necessary to point out where the details resemble and where they differ from the sections in the Rhætic and Trias of the Cardiff neighbourhood.

In both cases the red clay of the Trias passes up into a series of green clays with impure limestones, and on these the Rhætic black shales, containing marine shells, lie without any passage group of any sort. But whereas at Aust the black shales occur directly above the tea-green marls, at Penarth a hard siliceous conglomerate, full of rolled teeth and bones of fish and reptiles, separates the two zones.

The bone bed of Aust appears higher in the series like the proper Bone Bed of Penarth Cliffs, but in character it is more like the lower, or so called "Fish Bed," of the South Wales series.

In both sections the bone bed includes a number of pebbles of an impure limestone which is best matched in the limestones of the Tea-green marls. I regard this fact as indicating a slight movement in early Rhætic times, whereby part of the recently-formed Trias was exposed to destruction.

The character of the fossils in the bone bed too is worthy of note. Whereas teeth of Ceratodus, the wonderful living Diphoid fish of Australia, have been obtained in a perfect condition from Aust ever since Agassiz rendered the section famous by his researches, they have never been obtained from the Cardiff district except in the most fragmentary state.

Finally, at Penarth between the black shale series and the Lias with Ammonites, there is a well-developed series of limestones which at Aust shrinks to a few feet of thin earthy limestones, and the Ammonite zones occur almost directly on those containing Avicula contorta.

Fragment of the Geology of Pontypool.

By J. M. CHURCHILL.

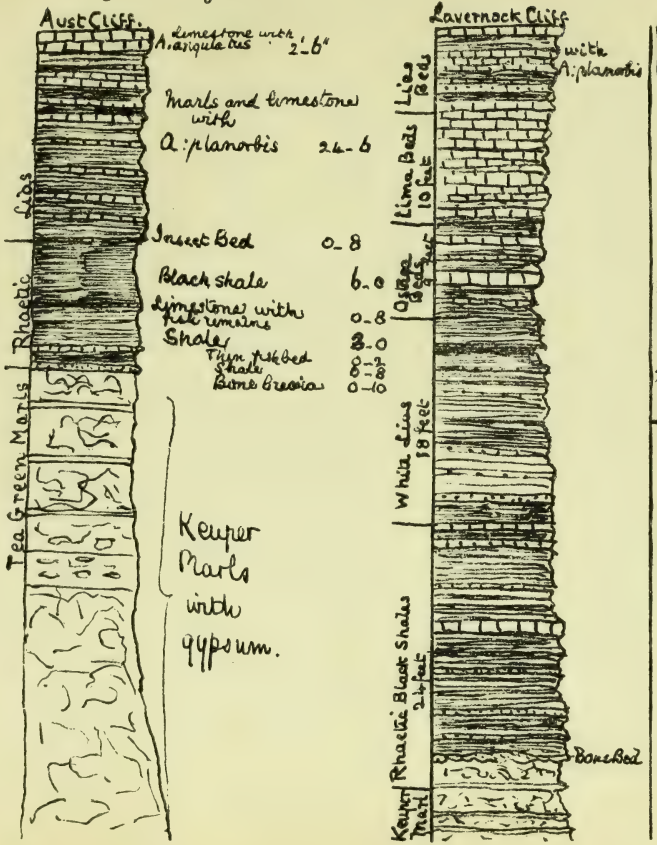
(Read in the Biological and Geological Section April 30th, 1896).

THE town of Pontypool, nestling quietly among the hills in the western part of Monmouthshire, presents to the geologist many interesting features. It lies nearly midway between Newport and Brynmawr, at what may aptly be termed the junction of two most picturesque valleys; one running southwards from Blaenavon, with a sharp bend at Abersychan, ending with the Old Red Sandstone plain just below Pontypool; the other almost at right angles to the first, extending from Crumlin, cuts across the strata in a transverse direction. Facing towards Blaenavon, the town is flanked on the right by a ridge composed of Old Red Sandstone on the east side, and of Carboniferous limestone on the west. This commences at Cae Brest, just above Pontypool Road Station, and ends in the Blorenge, the "great corner-stone of the South Wales coalfield," a distance of about seven miles. On the left appears the rounded outline of the coalfield, terminating in the Tranch Hill. The Crumlin Valley thus separates what would otherwise be a continuous coal basin. A small river, the Avon Llwyd, channelling its way from the mountains above Blaenavon, skirts the base of the above ridge, passes to the east of Pontypool, and continues its course to the River Usk, near Caerleon.

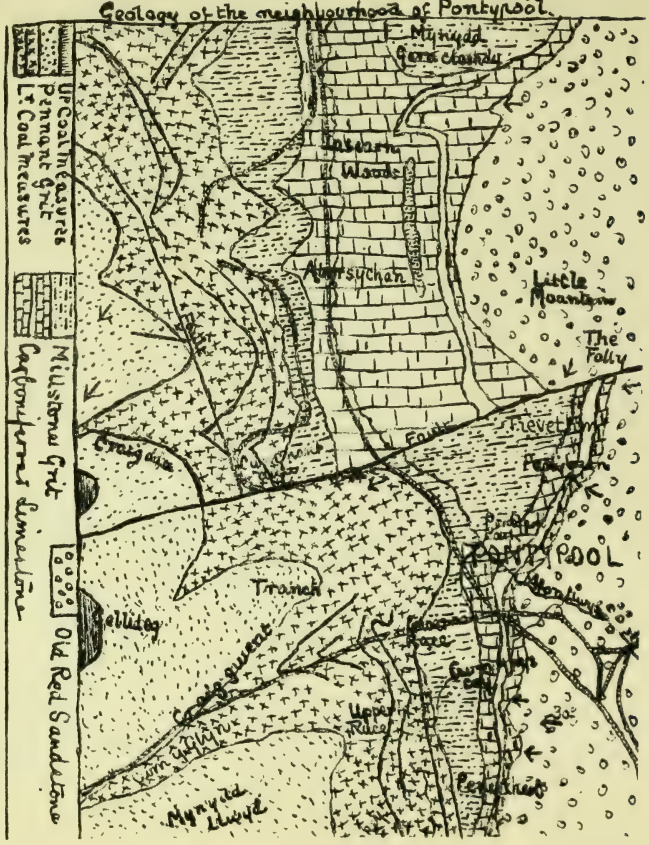
In examining the district one cannot fail to notice the action of the great denuding and disturbing agents that have been at work, and to which the charming scenery is due.

The various outcrops of strata with the lie of the beds show unmistakably that the axis of folding is parallel to that of the Forest of Dean, yet local disturbance has changed the "dip" in many places, *e.g.*, near Trevethin Church, and the great north and south anticline of Blaenavon and Abersychan.

Geological Sections.



Map (1 inch = a mile) of the



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The Old Red Sandstone which occupies the greater part of East Monmouthshire crops out behind Pontymoil School, and extends through the field a little higher up. The beds in this field are rather coarse in character, and, like the ordinary transition bed, yield easily to atmospheric denudation, and are crumbling to pieces. They contain a number of clay galls, which, on weathering out, leave small cavities resembling the external casts of shells, and might easily be taken for such. Traced along the field, the colour changes from red to yellow with brown spots, probably the result of reduction of the iron compound. It is just possible that this is the yellow sandstone, which shades from Old Red Sandstone to Carboniferous Limestone. In what appears to be an old water course, containing a quantity of water-worn material, a definite band of micaceous sandstone appears, containing small white flakes, rather soft, and with a tendency to crumble. This, no doubt, belongs to Old Red, and is comparable to that found in other places. These beds appear to pass quite conformably up to Carboniferous; at least, the surface does not indicate anything to the contrary, and a comparison with other parts of the district point, as we should expect, to quite a conformable change.

The Carboniferous Limestone is developed at three places—

(1.) In the well-known quarries at Abersychan, about two miles above Pontypool.

(2.) At Cwmynyscoy, or Cwm, about a mile below the town.

(3.) In a small quarry situated in the hilly field on the Park Estate.

We, however, shall only deal with that at the Cwm, of which there are five quarries, four belonging to Lower and one to the Upper Series.

Near the Clarence Goods Station, G.W.R., is a large disused quarry in the Lower Carboniferous. Upon examination nothing very striking appears. It consists of impure limestone, about 40ft. in thickness, with a dip of 18° to 20° west. The stone is fairly well bedded, soft, and weathers earthy, and of a greyish colour. There are, however, several vertical veins of barytes, with traces of lead ore. On the top a few encrinite stems were found, but the beds otherwise show a marked absence of fossils.

Passing through the field near the Intermediate School, we followed the path up over the field towards Penyrheol by turning through a gateway at the commencement of Cwmynyscoy village. The first quarry examined lies just under Ash Tree House, so marked on the District Survey map. This is essentially Lower Carboniferous strata with Middle Shale lying on the top of limestone, and presents a complete section from crystalline rock to black shale, with a dip of about 25° in a N.W. by W. direction. The limestone for the most part is oolitic, hard, and of a bluish colour, and breaks with a splintery fracture. A few thin calcite veins traverse the beds in an irregular way. It is exceedingly encrinital, and contains Productus with spines, Spirifer, Rhynchonella, and other Brachiopods. On the top are the Middle Shales, some nodular and fossiliferous (the nodules containing septaria with quartz and pearlspar), intercalated with a few thin limestone bands and three

Polyzoa beds, containing fish teeth, bones, and scales, abundance of Polyzoa, and a number of Brachiopods. These shales are perfectly regular, and on the exposed surfaces are soft and crumbling to pieces, and gradually filling up one side of the quarry.

The section here is as follows :—

ft.	in.	
28	0	Hard bluish limestone, with shale bands.
1	0	Black shales.
0	5	Polyzoa bed, containing fish teeth and bones.
1	0	Black shale.
0	5	Polyzoa bed.
5	0	Black shale, containing nodules with septarian structure.
0	4	Polyzoa beds.
6	0	Black shale, with shells and encrinites.
0	5	Impure limestone.
2	0	Shale.
1	2	Mixed limestone and shale.
5	0	Shales, with bands of limestone.
18	0	Probably shales and thin limestones.

Some 200 yards nearer the village is a second quarry, where the beds have the same characteristics and direction of dip. In one corner, however, the encrinites are better developed, and on the weathered surface their internal structure in section is well marked. The face of the beds is covered with much calcite, which in some places forms stalactites and stalagmites. The oolitic structure is to be seen to advantage in the weathered debris, and perpendicular and horizontal jointing is plainly observable. About the centre of the quarry is a large pothole, which from all appearance extended up through the beds which have been removed. A number of cracks and fissures, some of large size, are seen extending inwards, and of very irregular shape.

Coming still nearer the village, we find a third quarry, lying alongside the tramroad. Here again we have a complete section, inasmuch as the middle shales with the Polyzoa limestones, as measured in the first quarry, are to be seen in their proper position. The same physical features described above apply in this case also.

These quarries are the most fossiliferous of any in the neighbourhood, and, on examination, the conviction comes to one's mind that the marine conditions of this small area were peculiarly adapted for the development of the Carboniferous fauna.

The premier place, however, is occupied by the Polyzoa beds, which form the fish zone of the Middle or Shale Division. This zone is well developed in all three quarries, but especially in the two lower ones, where its position in the geological scale is clearly defined as coming near the base of the black shales, and just above the limestone series. The beds, however, are not of very great thickness, as reference to the above section shows. Altogether there are three distinct bands of about 14 inches intercalated between a series of black shales, containing teeth, bones and scales of fish, entomostraca, and Productus spines and shells. These beds are literally one mass of the broken remains of the

various kinds of organisms that existed at that time, and illustrate the abundance of marine organic life of the period.

These beds may be correlated with those of Mr. Storrie at Rhubina, specimens of which are in the Cardiff Museum, and which contain "numbers of teeth of small shark-like fish, shells of Mollusca, Echinoderms, and, everywhere, between these, countless numbers of valves of Entomostraca." Mr. Storrie's beds, however, are said to belong to the Lower Limestone Shale, but according to the new geological map (lately published) they belong to the same zone as those occurring at Pontypool. The same beds are also referred to by Mr. T. H. Thomas, in the British Association Guide for Cardiff, as occurring at Sweldon, and contain fish teeth and spines. Also in vol. I., Memoirs of Geological Society, pp. 106, 7, 8, 9, 21, Sir H. de la Bêche makes mention of fish bone beds of the Carboniferous period as seen in Pembrokeshire and at Bristol.

An interesting fact, and one which strikes the thinking geologist, is that the outcrop of the shales has been followed rather than that of the limestone. Consequently, we conclude that it is not the limestone in the main that has been sought for. An examination of the ground suggests that the shales contain iron. The presence of a band containing septarian nodules and the staining of both limestone and calcite prove t and historic evidence supports it, for in the 25-inch Ordnance maps 686, 230 and 234, we find it recorded that the Ebbw Vale Company had iron mines or levels in and around the Cwm quarries, from which they worked both iron and limestone in connection with their works at the Race, half a mile distant.

The following is a list of fossils from this section :—

Lower Carboniferous Limestone.

Productus semireticularis (?)
,, scabriculus.
,, costata.
,, gigantea.
Rhynchonella pleurodon.
Orthis resupinata.
Terebratula hastata.
Spirifer striata.
,, cuspidata or distans.
Athyris ambigua (?).
Streptorhynchus crenistria.
Conularia quadrisulcata.
Myacites.
Loxonema.
Actinocrinus.
Poteriocrinus crassus.
Ceriopora rhombifera.
Fenestella antiqua.
Cyathophyllum.
Portions of Calyx and stems of Encrinites.

Fish Teeth from Polyzoa Beds.

Psammodus porosus.
Deltoptichyus acutus.
Orodus ramosus.
Rhizodus.
Helodus.
Fish Bones.

Middle Shale.

Orthis.
Strophomena.
Spirifer.
Rhynchonella.
Aviculopecten.
Modiola.
Orthoceras.
Encrinites.

Continuing our walk up the valley, we come to a large quarry in limestone of massive structure from top to bottom, which belongs to the Upper Limestone series. It is a hard, compact, thickly-bedded stone of bluish colour, weathering grey. The beds lie at an angle of 18° to 20° in a W.N.W. direction. There is a conspicuous absence of fossils, only a few fragments of encrinites appearing in the loose material at the base. Near the limekiln is a crystalline deposit covering the face of the rock, which, on analysis, proved to be pearlspar. These quarries have therefore yielded quartz, calcite, barytes, pearlspar, and galena. In the left-hand corner is a very interesting section. Traversing the beds are several chert bands, lying one above another, in which silica has replaced the calcite of shells and of oolitic grains which now mass together in small agate structures. There are also several veins of barytes, in most of which a layer of calcite with dog-tooth crystals is intercalated between two layers of heavyspar, containing fragments of lead. Specimens of black crystalline limestone are seen showing good encrinital structure. Good fibrous calcite, tinted with oxide of iron was also found. The total thickness of this section is 70ft. to 80ft.

The Millstone Grit appears in many localities, and crops out in the side of the brook which runs down through Cwmnyscoy. On the mountain, near the Race Works, large boulders, thickly studded with quartz pebbles of various sizes, are strewn about in all directions, being evidently relics of many a land fall and deluge of past ages. In some of these blocks the pebbles present a flat joint face, as if having been sliced through with a knife, thus showing the tremendous force which must have been in operation.

In the wood to the right of the town are several small quarries, composed principally of hard siliceous fine-grained sandstone. In the lower, which is situated on the Mill Road, the compact rock is separated into two portions by beds of shale of a greenish colour, some of which are micaceous. In general the dip is to the north at an angle of 8°. When first worked, a few years ago, a small coal seam not thicker than two inches was noticed associated with thin shale containing calamites. A number of Coal Measure fossils are found scattered throughout the stone, with fair specimens of Sigillaria, one about a yard in length. Parallel with the road are several exposures which are noticeable between the trees of the wood. In one of these is an outcrop of coal 7 inches thick, and extends for some yards in length. It is fairly hard, and rests on a layer of shale. Above and below is solid rock containing tree markings. These beds seem to me to belong to the Pennant Series, which, as Symonds, in his "Records of the Rocks," says, "are of great thickness at Pontypool, and consist of soft and hard siliceous deposits containing Coal Measure fossils." Yet, according to the new map, they are marked as Millstone Grit.

The eastern edge of the great South Wales Coalfield, running from Brynmawr on the north, passes through Pontypool and Cwmbran, and extends through Risca on to the neighbourhood of Port Talbot.

On this edge, and in close proximity to the town, are several important collieries.

The Tranch Colliery, or slope, lies nearly a mile above Pontypool, just under Tranch wood. It is rendered famous by having a vein of Cannel or Horn coal lying directly underneath the workable Meadow Vein. The quality of these coals may be seen from an analysis made by J. W. Thomas, Esq., F.I.C., F.C.S., in 1880.

Cannel or Horn Coal.		Meadow Vein.	
Fixed Carbon	41·78 %	Carbon	76·73 %
Volatile matter other than Sulphur and Water ...	40·54 ,,	Hydrogen	5·23 ,,
Sulphur	2·99 ,,	Ogygen	7·78 ,,
Ash	14·32 ,,	Nitrogen	·67 ,,
Water (Moisture)	·37 ,,	Sulphur	2·81 ,,
		Ash	5·40 ,,
		Water	1·38 ,,
	100·00		100·00
Coke = 56·1 % on 11 1/5 cwt. per ton.		Coke 65·8 % on 13·16 cwt per ton.	
Yield of gas per ton = 11,867 cubic feet (corrected).		One ton yields 10,645 cubic feet of gas (corrected).	
Value of Coal in Sperm Candles 73,338 per ton.		Value of one ton of Coal in Sperm Candles 39.159.	

On the slopes of Cwmnantddu Valley, nestles the Llanerch Colliery. The chief feature of this working is the fossiliferous character of the coal. Ferns such as Neuropteris, Sphenopteris, and Pecopteris; Calamites, Lepidodendrons, and Sigillaria are abundant, and good specimens may be obtained from the tippings. This colliery, situated on the Lower or Ironstone Series, contains a quantity of clay-ironstone nodules, which are traversed with veins of calcite, and many beautiful crystals of the nail-head and dog-tooth type may be obtained.

The following is a section :—

No. 1 Pit, 253½ yards ; No. 2, 237 yards deep.

Pennant (with water).	ft.	in.		
Tillery Coal	2	6	...	72 yards depth.
Soap Vein	2	9	...	128 ,,
Red or Elled Vein	4	8	...	158½ ,,
Big Vein	5	6	...	167 ,,
Three quarter Coal	1	11	...	171 ,,
Yard Vein	2	0	...	174 ,,
Meadow Vein, only 5ft. of this worked	8	0	...	237 ,,
Coal	2	0	...	239 ,,
Coal	1	0	...	243 ,,
Old Coal	2	9	...	245 ,,

Mine ground, 8 yards.

Total depth to where Millstone Grit is reached, 223 yards 1 foot 7 inches.

Melody, Harmony and Rhythm.

By W. RÖNNFELDT.

Read before the Society on February 13th, 1896.

NOBODY who takes an intelligent interest in music can have failed to notice the great change which has made itself felt within the last thirty years in the selection of music for public performance, and in its appreciation on the part of the public. Composers like Donizetti, Bellini, and others, who were the general favourites, are now neglected, whilst Wagner, who was unable to obtain a hearing then, draws at present more crowded audiences than any other composer. Thalberg has given way to Schumann, Chopin and Grieg. Symphonies and chamber music, which were considered intolerably dull, now afford genuine enjoyment to many listeners. Not every change of taste in music has been a sign of progress; the history of this, like that of other arts, has presented phases of retrogression. The change to which I refer is, however, a real advance, and for it we are in the main indebted to Richard Wagner, even for the greater appreciation of classical music, though he himself was not a classicist, at least in composition.

If we examine the process by which this improvement has manifested itself in the case of each individual listener, and ask ourselves how he has been gradually brought to prefer the one class of music to the other, we shall find that it is owing to a better understanding of the relations between melody, harmony and rhythm.

Melody is defined as a combination of successive tones; harmony, as a combination of simultaneous or concurrent tones; but this definition does not help us very much. Harmony can be taught; it is subject to certain well known, though somewhat unstable, rules, and it can be

contrasted with its opposite, discord or cacophony. For melody we have no such rules or laws ; it is left to individual taste, and hence it is no wonder that opinions should have differed exceedingly as to what constitutes good melody. As usual, musical critics have been as hopelessly blind as any country labourer could have been. There never has been a first-rate composer whose merit has at once been recognised by them, and it is barely twenty-five years ago that they depreciated Wagner with a unanimity which would be ludicrous, if it were not so disheartening. It seems almost incredible that Wagner's Lohengrin was once characterised in the *Times* as an incoherent mass of rubbish, and his Tannhäuser, as tedious beyond endurance. Nay, in 1836, the musical critic of the *Times* even gave a tremendous slating to Mendelssohn's St. Paul, on the occasion of its first production in England, declaring it to be totally devoid of melody. Now, whatever may be thought of Mendelssohn's rank among the great composers, there can be no doubt that he is one of the most melodious of all.

The reason for the blind thus misleading the blind, was because they had no conception of the character of melody, and failed to see that melody and harmony are part and parcel of the same thing and can no more be separated, in reference to the impression they produce on the minds of the audience, than a flower from its scent, or a butterfly from the markings on its wings. We can speak of melody by itself; but the impression which a work produces, is or ought to be, dependent on the effect of both harmony and melody.

The same remark of course applies to rhythm. It appears a truism to say that the rhythm of a work ought to correspond with its character, that a dirge should not be written in a waltz measure, and that a drinking song must have a different swing from a lullaby. Yet it is astonishing how totally incapable the last generation, and most of all my friends the musical critics, were to grasp this simple point. They were not only content, but actually delighted, when Lucia appeared stark mad upon the stage and sang a waltz, or when Meyerbeer's Prophet sang a drinking song, also in a waltz tune, while the palace was actually on fire and on the point of crushing and killing him beneath its ruins. The greatest sinner of all composers was perhaps Verdi in all his earlier operas, with his eternal waltz, galop and march tunes. In order not to make my address too long and wearisome, I shall confine my remarks for the present to harmony and melody and refer to rhythm later on in my illustrations.

My object to-night, then, is to demonstrate to you that the beauty of a composition depends upon many factors,—melody, harmony and rhythm, to which must be added expression and treatment,—and that of these, melody is only one, and by no means always the most important, as has often been erroneously assumed. In order to prove this to you, I have, of course, had to choose illustrations which are deficient in what is commonly considered as melody ; but I nevertheless trust that you will not find them wearisome. I cannot do better than begin by telling you that melody by itself without harmony, either

expressed or implied, has no meaning whatever, and is altogether unthinkable. No doubt many of you may demur to this statement; for when you hear a street arab sing "The man who broke the bank at Monte Carlo," or whatever the latest favourite may be, you have a very distinct melody without accompaniment or harmony, and yet you can perfectly appreciate it as good or bad, each according to his or her individual taste. That is quite true; but the explanation lies in the fact that melodies which everybody can appreciate without accompaniment are based upon exceedingly simple harmonic progressions which your mind supplies instinctively and unconsciously. If you examine the matter you will be surprised how many of the compositions you have been in the habit of hearing, such as dances, marches, barrel-organ tunes, popular and drawing-room songs and airs from older operas, never, or hardly ever, go outside the range of the following simple harmonic progressions :—

Illustrations : "Three blind mice," requiring only two chords ; "Home, sweet home," which can be played with three. It is due to this circumstance that, what is called vamping in music, *i.e.*, extemporising an accompaniment to a song, is often so easy.

It is not surprising that any child, just as it learns its mother tongue without effort, should also learn, equally unconsciously, to apply these simple harmonies to any tune it may hear. As a matter of fact, everybody not only does so, but—unless musically educated, or specially gifted in regard to music—he or she will even judge the melody solely according to whether it does or does not go beyond those harmonies. A melody which requires more complicated harmonies will not be understood, and probably pronounced bad. As an illustration, I will give you the sailor's song from Wagner's "Tristan and Isolda." It is an extremely beautiful composition ; but, as it is unaccompanied, and requires a more intricate harmonic treatment than an ordinary hearer can supply for himself, I have no hesitation in saying that not one listener in a hundred will fully appreciate the beauty of the song when first heard in the opera. I shall add an accompaniment of my own—not, I fear, as Wagner would have done it, but merely for the purpose of filling in the harmony in the simplest manner,—and I have no doubt that this slight addition will already enable you to appreciate the song a little more. If even with such assistance you do not fully recognise the beauty of the song, there are two very good reasons for it : in the first place, its harmony and rhythm are somewhat obscure, and in the second, it is a peculiarity of all works of art of the highest order that their full beauty does not reveal itself all at once, but becomes more and more apparent with closer study and a more intimate acquaintance.

My next point will appear somewhat paradoxical, but is nevertheless true, as I hope to demonstrate to you, viz., that the beauty of a melody does not in the least degree depend upon the succession of tones of which it consists, and that no combination of tones can be imagined which could not with proper treatment be turned into a good melody. As an illustration, let us take a sequence of semitones; it is impossible to imagine anything less suitable for melodic treatment, and yet many extremely melodious passages, and even entire compositions, consist of, and are based upon, sequences of semitones, as the following examples will show:—

Duet from Jessonda of Spohr, whose works abound in chromatic passages of great beauty.

"Wotan sending Brünnhilde to sleep," from Walküre.
Air, "Star of Eve," from Tannhäuser.
Prelude to "Tristan and Isolda." } *Wagner.*

the last of which, though full of chromatic progressions, is one of the most perfect compositions in the world.

As a further example, I may mention the well-known and universally admired "Habanera," from Bizet's Carmen. Its principal air consists of a sequence of semitones which by itself would be considered totally unmelodious and extremely ugly; yet the song is beautiful and very effective, owing to its clever treatment and excellent rhythm.

I have now to call your attention to the fact that, though we are all in the habit of talking very glibly about melody, yet it is often difficult, and sometimes impossible, to fix a boundary line between melody and harmony.

Illustrations:—Der Tod und das Mädchen.
Der Mönch. } *Schubert.*

These examples, which are taken from one of the most melodious composers that ever lived, show that a melody must never be judged apart from its harmony. The fact is, of course, obvious enough and self-evident; yet, if musical critics had been able to grasp this simple point, Wagner would not have been misunderstood by them for thirty long years, as he was. The light in which I have brought the matter before you now will also make it clear why some persons considered his music to be infinite melody, while others denied him the gift of melody altogether. The latter simply did not know where to look for it. Wagner himself has compared harmony to a sea and melody to the surface waves, which is a very happy simile, since melody forms as much an inseparable part of the harmony which supports it, as the surface waves do of the sea.

This brings me to the consideration of two other factors to which I have referred before as important in determining the value of a composition, viz., treatment and expression. These terms are, perhaps, not very well chosen; but they have at least the advantage of explaining themselves. By treatment, I mean the way in which the composer has treated his subject; by expression, the manner in which his intention—or, in vocal music, the meaning of the words—has been interpreted by

him in the music. Confining myself for the moment to treatment, and without reference to expression, I think that Mozart ranks above all other composers. Nobody else has been able to construct such marvellous works upon such slender materials. I will give you as illustrations Osmin's first air from "Il Seraglio," which is as simple as it is beautiful, and the serenade from "Don Giovanni," a universal favourite, and, in fact, a perfect gem. Taken separately, neither its melody nor its harmony or rhythm presents any striking features; it is, moreover, extremely simple and short. And yet it possesses an indescribable charm, breathing, as it does, all the cheerful warm glow of the sunny south, together with the tender yearnings of love, and however often you may sing it, you never tire of it.

I will now shortly refer to one of the most charming compositions of Beethoven, the Allegretto of his Seventh Symphony. I have chosen it because, having hardly any melody at all to speak of, at least in the principal subject, and being constructed upon the most simple harmonies possible, it shows what can be done by a genius with the most unpromising materials. It owes its great charm, in the first place, to marvellously skilful treatment, and in the next, to a very fascinating rhythm which continues during the whole movement, even through a clarionet passage, which itself has a totally different rhythm.

The next illustration, "Landgraf Ludwig," by *C. Loewe*, though extremely simple in melody, harmony and rhythm, is a good example of expression, and deserves to be considered a beautiful ballad owing to the superlative skill with which the meaning of the words has been expressed in the music; and my last illustration "Ein Ton," by *P. Cornelius*, is also extremely interesting, because, having its vocal part limited to one note only, it has no melody whatever, and yet is attractive enough to anyone who understands and fully realises the meaning of the poem which the composer has set to music.

Perhaps no composer affords a better illustration of the relation between melody and harmony than Verdi. You all know, the middle-aged from personal recollection, the young from hearsay, what sensation his Trovatore, Traviata, and other works produced at the time of their first performance, and for many years afterwards. They were the principal attraction of the London operatic season, and his airs were a perfect god-send to drawing-room parties and barrel-organs. If we now take his latest opera, Falstaff, we find that his airs have lost that meretricious brilliancy which was formerly considered so great a charm; but that their melodies are far more refined and artistic, and that in his harmonies and rhythm he has, under the influence of Wagner, made such astounding progress that this last opera of his will be a source of delight to generations to come, which will look upon his older operas as only good to light a fire with. It is indeed a thing unparalleled in the history of art that a man, after having produced work of very inferior merit for a large number of years, should, in extreme old age, delight the world with a composition so excellent in every respect. Its great artistic melodiousness, the freshness and

filigree-like lightness of its orchestration, and its exquisite humour are such that one might believe it to be composed by a youth of twenty, rather than by a man of eighty years of age, and the favour with which the work has been received everywhere testifies to the improvement of the public taste.

As another illustration, I may mention Berlioz's Faust, which appears to be a great favourite at Cardiff, as elsewhere. I am inclined to think that comparatively few listeners have noticed how deficient in melody it is. Berlioz was, in fact, of all the great composers, one of the poorest melodists, and the unvocal character of all the solo parts in the work referred to, must be a sore trial to the artists engaged in its representation; but his orchestration is so brilliant, his colouring so vivid, and his rhythm so fascinating, that the absence of melody is apt to be overlooked.

In conclusion, I should like to touch upon a subject which is indeed too vast to be disposed of in a few minutes, but which I cannot leave altogether unmentioned. The reason why Wagner required so long a time to gain the appreciation of the public is because he introduced harmonic progressions, which were unknown before him, and the beauty of which people could not at first recognise. Now, if he thus expanded the boundaries of harmony, it was to be expected that other composers, encouraged by his example and his ultimate success, would follow him, and strike out fresh paths for themselves, and this is what has happened. I am referring now to operatic composers only, especially Mascagni, Leoncavallo, and Bruneau. Will they also be accepted as leaders? It is difficult to forecast the future; for music has not yet reached a stage of finality, and the very example of Wagner shows that it is capable of ever new developments, which will only very gradually be accepted. It is indeed very dangerous to dogmatise on such a question. There have been philosophical systems constructed by men like Dr. Hanslick ("vom Musicalisch Schönen,") and Professor Vischer ("System der Aesthetik"), to enable you to judge what is beautiful in music, and yet these very persons themselves were so blind as not to recognise the merits of one of the greatest composers of this or any other century, Wagner, who lived, moved, and worked in their very midst. They remind me of the tailors in the island of Laputa, who, instead of measuring a person for a suit of clothes in the same rule-of-thumb way as our tailors, first took his altitude by means of a quadrant, and then, with rule and compass, described the dimensions of his whole body. The thing was eminently scientific and ingenious; only, when the clothes were at last sent home, they did not fit. However, in the present case, I cannot help expressing my opinion that, whereas the change brought about by Wagner is a genuine advance, that introduced by the later composers I have named is rather a retrogression. The success of Mascagni and Leoncavallo was, in fact, mainly owing to the excellence of the plot and the libretti of "Cavalleria Rusticana," and "Pagliacci," whilst as musical composers, both these men rank below Rossini, Bellini and

Verdi.* Bruneau also is indebted for his success of "L'Attaque du Moulin" to the libretto, and, when, in this opera, he combines two parts of a chorus:

and thus:

the result is not music, but chaos. In order to enforce new laws of harmony, a titanic genius like Wagner is required; when smaller men attempt the task, the result will be, as it is in many of the new compositions I have referred to, an arid desert with but an occasional oasis of real melody and harmony.

* My opinion respecting Mascagni and Leoncavallo is based upon their earlier operas, their later compositions being so far unknown to me, except Mascagni's "L'Amico Fritz," which is very poor stuff. It is but fair that I should add this remark, by way of caution, as both these composers may yet do very good work, and should not be judged by their first productions exclusively, any more than Wagner by his "Rienzi."

Biological and Geological Section.

REPORT FOR THE 9TH SESSION, 1895-96.

COMMITTEE:

The PRESIDENT and HON. SECRETARY of the C.N.S *(ex-officio).*

T. H. THOMAS, R.C.A., *President.*

D. R. PATERSON, M.D., J. STORRIE, T. S. TREGELLES,
W. N. PARKER, PH.D., *Hon. Sec.*

SIX Ordinary Meetings have been held during the session, with an average attendance of 16·5. The number of members at present on the books is 46.

The following papers were read:—

1895.

Nov. 7th.—F. T. HOWARD, B.A.—"A Saurian Jaw from Lower Penarth."

" " F. T. HOWARD, B.A.—"A deep well-boring at Cardiff Docks."

" " T. H. THOMAS, R.C.A.—"A monstrous form of Plantago major."

" " A. PETTIGREW—"Note on a domesticated Wood-pigeon."

Dec. 5th.—R. DRANE, F.L.S.—"Vagrant Notes on Natural History."

" " F. T. HOWARD, B.A., and EVAN SMALL, B.Sc.—"The Geological and Physical Features of Skomer."

" " J. B. HAYCRAFT, M.D., F.R.S.E.—"Flint Chippings from Skomer."

1896.

Jan. 16th.—C. T. VACHELL, M.D., and T. L. HOWE—"Note on *Sirex juvencus*."

" " J. J. NEALE—"Natural History Notes."

Feb. 20th.—J. STORRIE and G. A. BIRKENHEAD—"On the Fauna, Flora, Archæology and Geology of Barry Island."

Mar. 19th.—F. T. HOWARD, B.A.—"On the Geology of the East Barry Dock." Part II.

April 30th.—J. STORRIE—"Note on the Peat and Silt Beds at Barry New Dock."

" " J. M. CHURCHILL—"On the Geology of Pontypool."

" " W. N. PARKER, Ph.D.—"Note on the Lungless *Salamandra perspicillata* and other animals recently collected in North Italy, as well as on a large Angler Fish *(Lophius piscatorius)*, 4ft. 9in. in length, recently obtained by Mr. Neale."

Besides the specimens shown in connection with the above papers, the following exhibits may be mentioned :—

By T. H THOMAS—*Riccia fluitans.*

By A. H. TROW—*Laminaria bulbosa.*

By T. L. HOWE—Collection of insects illustrating life histories.

By C. WILLIAMS (President of the Penarth Entomological Society)—*Sirex juvencus* and *Sirex gigas.*

By W. N. PARKER—Skull of wild rabbit with abnormal teeth.

By C. T. VACHELL—Rose-purple variety of *Oxalis acetosella.*

By A. H. TROW—The occurrence of *Fycnophycus tuberculatus* at Skomer was also noted.

A Field Walk to Barry Island took place on November 21st, 1895, when Messrs. Storrie and Birkenhead shewed members the various points of interest in connection with St. Baruch's Chapel, the Roman Well, and other excavations, as well as a collection of the specimens found.

The sum of £2 10s. was granted to Mr. Storrie, it being also suggested that the parent Society grant a similar sum, with a view to the thorough examination of the Peat Beds recently exposed at Barry.

The following resolution was proposed by the Hon. Sec., seconded by the Rev. Canon Thompson, and carried unanimously :—

"That the Biological and Geological Section of the Cardiff Naturalists' Society wish to record their sense of the honour done to one of its members—Mr. Storrie—by the Geological Society of London, in placing him this year on the list of recipients from the Barlow-Jameson Fund for research."

The accounts show a balance in hand of £12 18s.

W. N. PARKER,

Hon. Sec.

UNIVERSITY COLLEGE,
CARDIFF, *June 4th, 1896.*

Report of the Committee for 1895-96.

THE Committee have the pleasure of presenting to the members of the Society their 29th Annual Report.

The number of members at the close of last session was		458
Elected during 1895-6		28
		486
Deaths	6	
Resignations and removals	32	
		38
		448

They are thus distributed :—

Honorary members	8
Life members	19
Corresponding members	8
Annual subscribers	412
Associate	1
	448

The Committee regret the loss by death during the past session of Mr. Edward Fletcher, Mr. John Jones, Mr. Morgan Reynolds, Mr. H. Jefferies, Mr. J. M. Sims, and Mr. H. J. Vose.

The balance sheet shows a balance of £117 7s. 4d., carried forward into the new year.

The following is a list of the papers read before the Society :—

1895

Oct. 24th.—Annual Meeting. Inaugural address by the President—Rev. Canon Thompson, D.D.

Nov. 24th.—Mr. C. T. Whitmell, M.A., B.Sc., F.G.S.—"Recent Progress in Planetary Astronomy" (2nd paper).

Dec. 12th.—Mr. T. W. Phillips, B.A. (Lecturer in Geography at the University College)—"A Glimpse at Africa."

1896

Jan. 23rd.—Mr. T. W. Edgeworth David, M.A. (Professor of Geology in the University of Sydney)—"The Coal Fields of Australia."

Feb. 13th.—Mr. W. Rönnfeldt—"Melody, Harmony and Rhythm."

Feb. 27th.—Mr. Miller Christy (Member of the Hakluyt Society)—"Admiral Sir Thomas Button, K.T., of Cardiff, and his connection with a search for a North West Passage."

The following public lectures have been delivered :—

1895

Oct. 31st.—Mr. Carl Armbruster—"The Wagner Festival Performances at Bayreuth."

Nov. 28th.—Professor C. V. Boys, F.R.S.—"Ripples."

1896

Jan. 9th.—Dr. J. G. Garson—"Early British Races."

Jan. 30th.—Professor C. Stewart, M.R.C.S. — "Co-operation in Nature."

Mar. 12th.—Mr. Edward Whymper—"Scrambles in the Alps."

Mar. 26th.—Professor L. C. Miall, F.R.S.—"A Green Leaf."

The thanks of the Society are due to the members who have read papers, and also to those ladies and gentlemen who have entertained the lecturers.

During the past session the lectures and meetings have been held in the Queen Street Public Hall with the exception of the first one, which was held (by kind permission of His Worship the Mayor, the Right Honourable Lord Windsor) in the Assembly Room, Town Hall, and the fourth in the Lecture Theatre of the University College (by kind permission of Principal J. Viriamu Jones), on the occasion of Professor Boys' lecture on "Ripples."

The first Field Meeting was held on the 6th day of May, when a visit was paid to the Dowlais Works, Cardiff (by kind permission of E. P. Martin, Esq.) The visitors were conducted over the works by the local Manager, Mr. G. James, who explained the various processes

through which the iron passed, from the state of ore to the finished steel-plate. A hearty vote of thanks was accorded to Mr. James before leaving on the motion of the President.

The Annual Field Meeting (Ladies' Day) was held on July 1st, when a visit was paid to Thornbury and Tortworth Park. An account of the meeting has kindly been written by Mr. C. T. Whitmell, and which appears in this volume of Transactions. The chief business transacted at the meeting was the election of Mr. R. Drane as president for the ensuing session.

The third Field Meeting was held on the 10th day of September, when a visit was paid to Castell Coch Vineyard (by kind permission of the Most Noble the Marquess of Bute). The members drove viâ Whitchurch, and tea was served at the Lewis Arms, Tongwynlais. Mr. A. Pettigrew kindly conducted the party round the vineyard, and gave an interesting account of the culture on the Bute Estate, South Wales. After tea, Mr. Storrie gave an account of the Twmpath, the site of which was passed en route. It was intended to inspect the Twmpath, but the inclement weather prevented this being done. Upon the return drive to Cardiff, Mr. Storrie pointed out a bone bed of lower carboniferous shales.

During the year your Committee have, under the new rules, elected the Rev. George Grove, of Govilion, and Mr. T. L. Howe corresponding members of the Society.

To the officers of the Society the Committee are indebted for the services rendered by them during the year in their respective offices.

Since the last report of the Committee two parts of the Transactions have been issued, viz.: Part 2 of Vol. XXVII., and Part 1 of Vol. XXVIII., the former containing a number of beautiful illustrations to the paper by Mr. William Riley on "Intrenchments and Camps on Mynydd Baidan and Mynydd Margam," the cost of which has been entirely defrayed by him.

Your Committee much regret having received the resignation of Mr. F. T. Howard, M.A., upon his appointment one of Her Majesty's Inspectors of Schools, and removal to London. Mr. Howard has been a member of your Committee for four years, and has rendered most valuable services to the Society. He has contributed numerous papers to the Transactions, containing the results of his own research.

Your Committee have made arrangements for the holding of the meetings during the ensuing session in the new Cory Memorial Hall.

Cardiff Naturalists' Society.

Balance Sheet for the Year ending 30th September, 1896.

Liabilities.

	£	s.	d.
To Sundry Creditors	91	17	8
,, Subscriptions in Advance	1	1	0
,, Conversazione Reserve Fund	31	0	6
,, Exploration Reserve Fund	4	9	1
,, Balance being excess of Assets over Liabilities ...	117	7	4
	£245	15	7

Assets.

			£	s.	d.
By Value of Furniture			9	3	0
,, ,, Library			6	5	1
,, ,, Reports unsold			10	0	0
,, ,, "Flora"			1	17	6
,, Sundry Debtors			3	13	7
,, Subscriptions in arrear			2	2	0
,, Investments, viz :—					
£112 Barry 4% Preference Stock	£127	0 7			
Cardiff Building Society ...	56	16 5			
			183	17	0
,, Cash in Lloyds Bank	27	11 5			
,, ,, Hon. Treasurer's hands ...	1	6 0			
			28	17	5
			£245	15	7

Dr. Revenue Account for the Year ending 30th September, 1896. *Cr.*

	£	s.	d.
To Reports and Transactions	49	16	5
,, Field Meetings	8	8	10
,, Lectures	107	11	0
,, Members' Meetings	28	9	2
,, Stationery, Printing and Advertising	28	15	6
,, General Expenses, including Collector's Commission	30	1	8
,, Donation to Workmen's Library, Dowlais Iron Works ... £2 2 0			
,, Incidental Expenses... ... ... 3 18 11			
	6	0	11
,, Conversazione Reserve Fund	9	19	6
,, Written off for Depreciation of Library... ...	1	0	0
,, ,, ,, ,, Furniture ..	1	0	0
,, Balance to be carried to next year's Account ...	117	7	4
	£388	10	4

	£	s.	d.
By Balance from last year's Account	149	12	0
,, Subscriptions ... ... £232 16 c			
,, ,, Associates ... 0 2 6			
	232	18	6
,, Interest	5	19	10
	£388	10	4

W. RONNFELDT,
Hon. Treasurer.

CARDIFF, 15th October, 1896.

WENTWORTH H. PRICE,
Chartered Accountant, *Auditor.*

CARDIFF, 19th October, 1896.

Report of the Hon. Librarian for 1895-96.

OF sixty-one Societies on our exchange list, Transactions have been received from forty-five during the current year, a complete list of which is herewith given.

All the publications received by this Society are deposited in the Central Public Library, and may be borrowed by any member of the Society on application to Mr. Ballinger or to one of the assistants. The thanks of the Society are due to Mr. Ballinger for the attention he bestows upon the Society's library.

R. W. Atkinson,

Hon. Librarian.

List of Societies Exchanging and of Transactions received from October 1st, 1895, to September 30th, 1896.

Astronomical Society of Wales; Journal, vol. I., parts 4, 6, 7, 8, 10-12; vol. II., 1-9.
Bath Natural History Society; Proceedings, vol. VIII., part 3.
Belfast Naturalists' Field Club; Vol. IV., part 3, 1895-96.
Belfast Natural History Society; Report and Transactions, 1894-95.
Berwickshire Naturalists' Club; History, 1894.
Brighton and Sussex Natural History Society.
Bristol Naturalists' Field Club; Proceedings, vol. VIII., part 1.
British Association; Annual Report.
Buenos Ayres, Annales del Museo Nacional; Tomo IV., 1895.
Chester Society of Natural Science; 24th and 25th Annual Report, 1894-95 and 1895-96.
Christiania, University Library of, En Rackka Norske Bergarter, af. Dr. Th. Kjerulf.

Cornwall, Royal Polytechnic Society ; Annual Report, No. 63.
Dublin Royal Society ; Transactions, vol. V., parts 5-12 ; vol. VI., part 1 ; Proceedings, vol. VIII., parts 3 and 4.
Dumfriesshire and Galloway Natural History Society ; Transactions, No. 11, 1894-95.
Dulwich College Science Society.
Ealing Microscopical Society ; Report and Proceedings, 1894-95.
Essex Field Club.
Glasgow Geological Society.
Glasgow Natural History Society ; Proceedings and Transactions, vol. IV., part 2, 1894-95.
Glasgow Philosophical Society ; Proceedings, vol. XXVI.
Hampshire Field Club.
Hertfordshire Natural History Society ; vol. VIII., parts 6 and 7 ; vol. IX., parts 1 and 2.
Holmesdale Natural History Society ; Proceedings, 1893-95.
Isle of Man Natural History Society ; Yn Lidar Manninagh, vol. III., Nos. 1 and 2.
Leicester Literary and Philosophical Society ; Transactions, vol. IV., parts 1-5.
Leopoldina ; Heft 31. Also Beiträge zur Kenntniss der Coniden.
Liverpool Geological Association ; Journal, vol. XV.
Manchester Field Naturalists' Society ; Report and Proceedings, 1895.
Manchester Geographical Society ; Journal, vol. IX., Nos. 9-12 ; vol. X., Nos. 10-12 ; vol. XI., Nos. 1-9.
Manchester Geological Society ; Transactions, vol. XXIV., parts 2-9.
Manchester Microscopical Society ; Annual Report and Transactions, 1895.
Marlborough College Natural History Society ; Report, No. 44, 1895.
Minnesota Academy of Natural Science.
Missouri Botanical Garden ; 7th Annual Report, 1896.
Monmouthshire and Caerleon Antiquarian Association.
Montevideo, Annales del Museo Nacional ; parts 1-5.
New South Wales Geological Survey ; Records, vol. IV., part 4 ; vol. V., part 1.
Norfolk and Norwich Natural History Society.
Northamptonshire Natural History Society ; Journal, Nos. 61-64 and Index.
Northumberland and Durham Natural History Society ; Transactions, vol. XIII., part 1 and part 2.
Nottingham Naturalists' Society.
Nova Scotian Institute of Science ; Proceedings and Transactions, vol. I., part 4 ; vol. II., part 1.
Philadelphia Academy of Natural Science ; Proceedings, 1895, parts 2 and 3 ; 1896, part 1.
Porto, Annaes de Sciencias Naturaes ; vol. I. and II. ; vol. III., Nos. 1-3.
Rochdale Literary and Scientific Society ; 17th Annual Report, 1895.
Royal Microscopical Society ; Transactions, 1895, Nos. 4-6 ; 1896, Nos. 1-4.
Sheffield Naturalists' Club ; 24th and 25th Annual Reports.
Smithsonian Institution.
South Eastern Naturalist ; Transactions, vol. I., part 5.
Southport Society of Natural Science.
Staffordshire (North) Naturalists' Field Club ; No. 29.
Stockport Society of Naturalists.
Swansea Scientific Society ; Annual Report and Transactions, 1894-95.
Toscaña, Societa della ; Atti, vol. IX., May, July and November, 1895 ; January, March and May, 1896.
United States Department of Agriculture.
United States Geological Survey ; Annual Reports, 15 and 16 ; Bulletins, Nos. 123-134.
United States National Museum ; Report, 1893 ; Proceedings, vol. XVII. ; Bulletin, No. 48.
Upsala, University of ; Meddelande, Nos. 14-18.
Wisconsin Academy of Sciences, Arts and Letters ; vol. X., 1894-95.
Woolhope Club.
Yorkshire Naturalists' Union ; Transactions, part 18, 1893.

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The President's Inaugural Address.

October 29th, 1896.

By R. DRANE, F.L.S.

Ladies and Gentlemen,

> From the warm ashes of the one who dies
> See a new President before you rise.

THIS Society first opened its eyes in a little room behind a chemist's shop in 1867, when there were but three persons present—Mr. Phil. Robinson, Mr. R. Rhys Jones and myself, and I alone of these am with you now. For these reasons, and because I am the original life member, I may, in some sort, claim to be its founder. To-night, in an allegorical sense, I am espoused to my first love—an old batchelor to a mature bride, the relict of some 29 husbands. But the bride I wed to-night has yearly put on youth; and if in person I am old, yet still in heart I too am young, and feed the hope that this our union may be happy, and that at my presidential death she may accept her 31st, refreshed. On such occasion as that which I have symbolised it is expected of the bridegroom that he makes a speech, sometimes he likes the doing so. Conscious of victory, uplift with confidence, full of capacity, and bursting with joy, he needs the bridle rather than the spur, for within him are beatitudes which do exceed by far the number of those formulated as sufficient for us. But sometimes he does not and would fain be under the table—the glowing picture fades, ideas confuse themselves and flee, his tongue cleaves to the roof of his mouth, and instead of the happy and fortunate fellow that he is, he conceives of himself as portentously ridiculous, and feels, alas poor, poor man, he feels like a toad under a harrow. There are, of course, degrees of difference twixt these extremes, but from the toad I am not far. I dislike visibility as constitutionally as owls the sun at noon, and have

not desired the distinction which you have conferred. I do not possess that order of capacity which is essential to those who would preside. That man is a poor thing and a cowardly, who cannot apply to himself the standard of comparison by which he assesses the aptitudes of others; but as you have chosen, you must take me for better or for worse, and be indulgent to my natural shortcomings. No man can add a cubit to his stature.

Now let me to my text, for I take it that a president of a Naturalists' Society should talk of natural history, profitably if he can, but at least, talk. So I shall submit to you my conception of the value of that knowledge of nature which results from the study of it. The great, the essential, value of that study is expressed in the one word "Peace"—whether that peace is worth your acceptance, or whether it will pay you —you must decide.

The scientific knowledge of nature is reserved for the few, its peace is open to all, and which of you will not renew the ancient prayer, "Give peace in our time, O Lord"? I know that they will not, whose breath is agitation, and whose vesture smells of blood—Alexander —Bonaparte—and he upon the Bosphorus. The value of peace is implied in the question, Art thou come to torment us before the time? In the deprecation "saying peace, peace when there is no peace." In the promise "There is a calm for those who weep, a rest for weary pilgrims found, they softly lie and sweetly sleep low in the ground." This last has, to my ear, something of the tone of a promissory note unlikely to be paid at maturity. But I am not about to delude you with a worthless bill upon the future, but would give you cash instead. I do not offer you choice food when hunger shall have finished work, and appetite no longer moves the toothless jaw, but rather bid you come, to-day, to feast on fat things, and wine upon the lees.

Let us go home, take holiday, be boys and girls again with mother. Forget our trumpery rivalries and vapid shows—the selfishness, the dust and hurry of the world—its torments ere the time.—Let us walk through green pastures and beside still waters with nature, mother nature, for in very deed "her ways are ways of pleasantness, and all her paths are peace."

Let Alexander weep no other world to waste, and, drunken, kill his friend,—let Wolsey dominate his king, and scheming die, ere yet he fills the chair of him who thrice denied his Lord,—and let Napoleon wade, knee deep in blood, to cancerous death on lone Helena's isle. What wot they of *their* glory now? They ate the *ashes* of the dead sea fruit, and what are *they* who *did* prefer one hour of glorious life to eons of repose, and scoffed at the valley of rest as some sleepy hollow, "where the sons of the soil, whether stupid or clever, are free to do nothing for ever and ever?" The repose obtainable through a knowledge of nature is a peace of another order, and certainly does not consist in the doing of nothing for ever and ever. To make the distinction plain I must take a retrospect,—what passed for Natural History from the dark ages almost down to our own time, was largely invented by

knaves for the acceptance of fools; and under their influence men lived in a hideous inferno, whose regnant dieties were Superstition, Cruelty, and Ignorance, and whose dark vault was filled with baneful stars, and still more evil moon.

Let us take an example or two. The dread of the raven as a bird of illomen takes form amongst us in the superstitious fears which some persons of my acquaintance still retain, and refuse to be comforted by common sense. To them it "tolls the sick man's passport from its hollow beak, and in the shadow of the silent night doth shake contagion from its sable wings." When her young are hatched "she will give them no meate until she see whether they be of her own color or no," that is, until they be penne-feathered," up to which time they subsist upon the dew of heaven—for doth not the kingly prophet David affirm —"He giveth fodder unto the cattell, and feedeth the young ravens that call upon him."

Of the ram it was believed that "when he sleepeth, from spring-time to harvest he lyeth on the one side, and from harvest to spring-time again on the other side."

Of the phœnix we have the most circumstantial account. "He hath a crest of fedders upon his hed, more gret than the paocok hathe, his nekke is yalowe, his bek is coloured blew, his wenges ben of purpre colour, his taylle is yelowe and red, and he is a fulle faire bird to loken upon for he schynethe full nobely." The phœnix alone had no share in Eve's transgression, when she ate of the forbidden fruit. "There is never more than one of these birds at one time in the whole world, for after living many hundred years it burneth itself, and from its ashes ariseth another." The comment on this myth is very curious. "It seemeth not only repugnant unto philosophy, but also holy Scripture, which plainly affirmeth that there went of every sort, at least two, into the ark of Noah, and it infringeth the benediction of God—'Be fruitful and multiply'—which terms are not applicable to the phœnix." But we may dismiss such natural histories by saying that they are the dying accents of a lost religion's voice whose unintelligible tongue still mumbles down the centuries; still they are not the pure nonsense which they seem, and belong rather to mythologists than to naturalists.

We get nearer to what seems possible when we are told that the common badger has its legs longer on the one side than the other, and that the ermine so dreads defilement that it will rather die than pass through filth to its escape. A belief so generally and deeply imbedded in men's minds that its white fur is still amongst us used to line the robes of judges and of kings, as type of incorruptible and spotless purity. Most of these beliefs might easily have been disposed of by a little personal observation, and yet they have been handed down unquestioned for a thousand years. The inventor of a lie may repeat it till he thinks of it as truth, as in the case of one who, when first he saw a living lion, said: "Call *that* a lion? Why, I have painted lions rampant, lions passant, and all sorts of lions, these five and twenty years, and for sure I *ought* to know what a lion is like better than that."

This was truly almost the only kind of natural history until quite recent times, and even now amongst ourselves it is by no means dead.

Let us take another view, and pass from myth to science. "Science visits with a not long deferred exposure all our fondness for preconceived opinions, all our partiality for views which we have ourselves maintained, and thus teaches us the two best lessons that can well be taught—The Love of Truth and Watchfulness in the use of Understanding." (*H. J. S. Smith*).

Come then, walk by the still waters of the Truth, for they run deep, and the lessons that they teach are less like toil, than "early rain upon the tender grass." I fear I clothe my plea in so phantastic dress that you will think I am not serious—nay, rather the more earnest I. 'Tis only but to-night we are espoused, and in the honeymoon, "Soft nothings in an idiot ear" are still permissible, for though the outer pagan sneer, they still are messages of love well understood of them to whom they are addressed.

But *are* my words soft nothings in your ears? And are there none who hear me now who wander—wonder—worrying what surely to believe?

Why this, and this at least, That familiarity with natural laws, is familiarity with the presence of God. And "Enoch walked with God, and he was not, for God took him." I use no cant, I mean precisely *that*.

To think, to know, to feel as David did when from his heart he cried, "If I ascend up into heaven Thou art there. If I take the wings of the morning and dwell in the uttermost parts of the sea, even there shall *Thy* hand lead me, and Thy *right* hand uphold me. If I make my bed in hell, behold Thou art there." This all pervading God is the God of nature, the knowledge of whom is peace.

Verily "there *is* a light that enlighteneth every man that cometh into the world," and who shall retort to God that it sufficeth him not? "Shall the pot say to the potter, what doest thou?"

That man who, with clean heart, shall study nature may attain to peace, for though on earth his feet may be, his head in heaven is high, already nimbus crowned with light.

Let Natural History then yield up to us its truths.

Is it not a curious thing that the duck, as soon as hatched, takes to the water, and though untaught is quite expert in the capture of its agile living food, but later on, in its adolescent stage, it is less so, and has become a more or less helpless flapper, with wings unfit for flight, and is easily destroyed? The special care of God *has* been, in a sense, withdrawn, and in its place are given faculties sufficient for its ends—a larger liberty, with personal responsibility imposed.

So, also, with the young wild swan when it first tries its wings, for if when passing overhead great noise be made, it cannot fly, and with closed pinions falls to earth, undone.

These are "inferior things," but like to them the babe new-born without instruction feeds, but ever after, all through life, the essential

conditions of his being are wholly placed outside his own control. Even in unconscious sleep he breathes, and when awake he cannot hold his breath. He hungers and he eats—so far he *must*, but further cannot go. Digestion does the rest in its mysterious way. Repudiating *his* authority it asks no leave nor makes a confident of *him*. So also his blood circulates, and circulated centuries of centuries before he ever knew it did so. With every other function too, it is the same. This is the realm of God in which no will but His is known. According to Paley, instinct is a propensity prior to experience and independent of instruction. The non-essential details only are the province of free will, and why? Because his Father careth for him, and not a hair of him shall perish without that Father's knowledge and assent, and thus far that care is of the animal man only.

Now hear me ask, and answer as you will: Think ye he made your orphan souls less well equipped to fight their homeward way? And if he has not so, then here is peace, and knowledge of His ordered way is the straight path to it; for here He moves by laws well fixed and obvious from the inevitable pains that follow their infraction, for there is no escape. Egyptian darkness hid not from men's eyes the law "Thou shalt not kill," or Moses had not fled long years before the tablets writ on Sinai.

God gave man, as his birthright, fixity of law, and in that fixity, His peace.

Let us to the dormouse for a hint. Never was there a more amiable innocuous creature than this tiny squirrel. I have had many of them and I never knew one bite, nor ever heard gamekeeper, farmer, gardener, or fool slander it as vermin. It is small, timid, powerless, pretty, clean, and so retiring that 'tis seldom seen. It sleeps full half its life, and for weeks or months together is so cold that it would hardly seem to live. It feeds on acorns, crab apples and wild nuts. Not even the all-grasping selfishness of man has thought of it despitefully. It is very meek and very happy. It seeks no distinction, and I am quite sure it would not, if it might, be president, yet it fills its appointed place as completely as the tiger, rhinocerous, or whale; *they* are respected, *it* contemned. "Blessed are the meek." "The race is not always to the swift nor the battle to the strong," for God has "chosen the weak things to confound the things that are mighty." Bears, lions, wolves, hyenas, are all gone from *us*, and this small, happy, innocent, remains. I *have* considered its ways, and I *have* heard—these mine own ears have heard—man's "ruling passion, strong in death," wail out, within an hour of the end, "I take no position, I take no position." Surely the dormouse here a chaplain fit had been—and what a text for it, that wail!

I admit no radical distinction between myself and an oyster, or for that matter, a potato, but regard it as one of degree only. Man is an "item"—to say the pleasant thing—chief item in creation's scheme, and in its God-wrought whole, an item, though it no position take, I am content to be. Dormouse, item, sovereign prince, what matters it?

for "This is all that remains of the emperor Saladin." When will men discern and women know that 'tis not the abundance of their goods that gives the spirit peace—that *peace* is an internal attitude of mind, not an external condition; and that the shortest, easiest road to it is nature's open way? I do not believe that anyone deserving the name of naturalist can be otherwise than happy, and as a consequence a kind-hearted man—a peace-maker much rather than a peace-breaker, and "Blessed are the peace-makers."

I *may* be suggesting "a fool's paradise" to *some*, aye *many*, nay *most*—but I am talking to *you* and not to the world: be ye "*in* the world but not *of* it." Love of retirement and peace do not well suit the world, and fail as completely as the Christian teaching itself has failed for these two thousand years, for few are chosen of the many called. I *may* be a dreamer—"Dreams are all true *while they last*"—go, ask Napoleon; and life's long dream is peaceful to the few, painful to the many, and, I would reduce the majority. The knowledge of nature helps to do this, for she says, "At the roaring loom of Time I ply, and weave for God the raiment that ye know Him by." I have spoken of the general advantage of a knowledge of nature; I will name a specific one. When, to the lover of nature, the "evil days draw nigh when we shall have no pleasure in them"—his study of it keeps his interest young and his mind fresh, long after he can no longer race, fight, hunt, nor even fish: "In vain for him returning seasons roll who has eternal summer in his soul," until the inevitable hand so gently steals away his senses, shuts his sight, that, when the everlasting doors stand wide he shall pass through and ask, amazed, Can *this* be death? Of the true naturalist it may be said "he must, he is, he cannot but be, wise;" and if in wisdom be no peace, where shall we seek its shrine? But he must *know* more of nature than the heraldic painter of the lion, and *do* more than discriminate between a lion and a flindermouse. "Birds is animals, and crabs is fish, but tortoises is insects."

The most intimate knowledge of Him, whose ways are past finding out, which is possible, is that which is obtained at first hand—from original documents—authentic, unrevised and unreviseable—no translation, transcript, or recension. Think of the thing I say—that the knowledge of nature is the knowledge of God, so far as it goes. I do not say that nature is God, but the raiment that ye know Him by. The knowledge of nature is the knowledge of truth, the knowledge of truth is the knowledge of duty. The knowledge of nature, truth, and duty is the knowledge of God. A knowledge which we possess in co-partnership with animals, for I will tell you a pathetic story in illustration.

One autumn eve, the Ettrick shepherd, Jamie Hogg, was in his bothie with his collie dog, when came some heavy unexpected snow. He told the dog, "Go, fetch the sheep in from the west, I to the east will go," and they went out. Hogg from the east brought in his sheep—the dog came not. He waited long, and feared both dog and sheep were lost in some deep snow, and slept, when presently, awakened by

the sound of scratching at the door, he opened it, and found both dog and sheep were there. The dog had something in her mouth, and left it in her master's custody, then disappeared; when sometime after other scratchings came, there was the dog again, and there another puppy given to his care. Then the dog licked her master's hand and died.—Command obeyed and duty done though death itself were goal. How many here to-night *could* do what that dog did without the bribe of a reward or balance of eternity?—for this is no romance, 'tis history. And what could human hero have done more? "But the poor dog, in life the firmest friend, the first to welcome, foremost to defend, unhonoured falls, forgotten all his worth, denied in heaven the soul he held on earth." That dog its duty did, by dogma all untaught, by interest all unbribed, while we are tutored from our cradles up in the idea that honesty *pays* best. The Church for centuries has held us o'er the abyssmal gulf to lure us into rectitude, appealing to our greed and trading on our fears of punishment. We are trained hucksters bargaining for vantages with God.

In "The English Schoolmaster," published in 1596, I find this child's first reading lesson, in words of one syllable: "Boy, go thy way to the top of the hill and get me home the bay nag. Feed him well, so that he be fat, and I will rid me of him, for he is but dull. If a man bid well for him, I will tell him of it, or I do but rob him, and so God will vex me, and may let me go to hell." I note that this Elizabethan horse-dealer says, "So God will vex me," *not* I shall vex God. So that in consideration of God not "vexing him" he might be *induced to be* honest *if* sufficiently paid for it. May I extend a little this monosyllabic morality: Think you he was a man in the true sense, and would you buy a horse of him if you were no judge? No, he was a mean man who did right from fear and not as did that dog.

Who that has dreamed in the soft gloaming of a warm September eve, and listened to the grasshoppers chirping in their happiness, has not found himself among the fairies and felt that he was drawn to nature by some hidden hand? Felt that he understood the ancient groping after truth which found expression in the old time religious myths? If he has not felt this, he is "but dull," and has scant sympathy with those long ponderings by which he has, or might have had, so fully profited—a superficial, and, therefore, supercillious man, who in his folly calls nature's whole field "secure and blest above where every orchard is o'errun with Gods." "He is the free man whom the truth makes free, and slaves are others all."

But lest I go, perhaps, too far afield, let us look into a rock pool which the receding tide has left well tenanted with hermit crabs, and you shall see the drama of our human life enacted for your benefit. Such tumbling and fighting, competing and biting, such toiling and sweating, finessing and fretting for that which is nought, that if the study of nature shall have taught you, *so* to look at life as to see it whole, not through the medium of its trivialities only, you will laugh consumedly at their comic presentment of our ways, and may be you

will fall athinking whether in our own world it is not well to take no part in the ignoble strife of such a pool. For such a pool we do inhabit, whose waters are not troubled by angelic agency but by an unclean spirit's rage. Little has he, the greatest man, to give, I keenly *crave*, and nothing, nothing, that I need. There is no power can take what I possess. No man so high but I am still his peer—nor none so humble but I take his hand, and grasp him to me, if so be that guile is not in *him*. And think you this a vain, mendacious boast? Come, stand upon some headlong cliff, take in the meaning of the sea ; or walk we in still woods, deep shadowed with mysterious gloom, peopled with unfamiliar things, blue domed of heaven, and carpeted with flowers, absorb and make their calm your own, and you shall *feel* 'tis true, for daily in the presence of the Deity ye still may live, and nightly covered by his wings may sleep. This is no late discovery which I am wishing to disclose, or which I claim. You know what the "kingly prophet David" said, and Marcus Aurelius Antoinus Pius, Emperor of Rome—one of the noblest of mankind—thought of his own imperial state as of a thing outside himself, and *less than he*. If these have felt it why not we? It was true to them and why not to ourselves. To the brave heart and to the steady head 'tis ever true.

> All discord, harmony not understood,
> All partial evil, universal good.

One illustration more for human pride's especial benefit. In the dull days of the next coming month, that humblest of our birds, the hedgesparrow, may be heard happily singing amongst the dead leaves on the ground, while searching for its food. To see and hear it while 'tis thus engaged is one of the most enchanting episodes which nature can present. I have heard it contended that this bird *has* no song, which proves how completely its still small voice, most musically toned, when every other voice is dumb, escapes the ear attuned to listen only to the loud, and yet it speaks so to the heart as only heavenly presence can. For when with chill November's breath the leafless branches moan, the hedge accentor, singing, saith, Be glad ye low and lone. Shakespeare says that in time of peace "Nothing so becomes a man as modest, stillness and humility," and the best of all schooling for the attainment of these graces is the reverent study of nature.

"It is easyer and perhaps better to *know* the truth than to *vtter* it or to be thereunto inopportunely vrged."—(A brief and close confutation, &c., of 1603, p. 207).

> But there are covert moments fraught with a divine repose,
> Which neither creed nor hoary myth nor sanctioned dogma knows,
> When groping doubt and crouching fear are unsubstantial forms,
> And the calm soul securely waits above polemic storms ;
> Aye, moments when the strenuous soul uplifts its brimming eye,
> And sees with a tumultuous joy clear God in cloudless sky,
> Hears thence its Father's voice respond to its ecstatic cry,—
> My Son—and swoons into the arms extended from on high.

Good-night, Good-night, and to divine repose.

Admiral Sir Thomas Button, Kt., of Cardiff.

By MILLER CHRISTY.

(Abstract of a paper read before the Society.)

BUTTON was born near Cardiff rather more than three centuries ago, and is one of its leading local worthies. He achieved considerable distinction in the naval service of his sovereign, and is worthy of honorable recollection for the fact that he commanded one of the earliest and most important expeditions sent out from this country in search of a North-West Passage. His family, for several centuries, occupied a position of considerable prominence in the county.

In 1612 it was fully believed by all the leading geographers that the much-desired and long-sought passage westward to China, Japan, and the Indies by way of the north of America had, at last, been actually discovered, and that nothing remained to be done but to equip another expedition to sail through and explore it. Such expedition was, therefore, got ready, and sailed in the spring of the year under the command of Sir Thomas (then plain captain) Button This Thomas Button was the fourth son of Miles Button of Worlton, in the parish of St. Nicholas, tho' this name for the present "Duffryn" is entirely forgotten in the neighbourhood. The exact date of his birth is not recorded, but it probably took place about the year 1570. The earliest information we have concerning him is to be found in the State Papers in the Public Record Office,* whence we learn that on the 7th of

* State Papers. Domestic. Elizabeth. CCXLI. 40.

February, 1591-92, there was granted to him and to his two elder brothers, William and James, a patent under Her Majesty's seal, conferring upon them jointly and severally the right to appear as attorneys, but on behalf of plaintiffs only, in any of the courts or hundred courts thereafter to be held by the Sheriff of Glamorgan. It seems, however, that Button never seriously followed the Law as a profession, for in the same year (1592) he joined the Naval Service of the Queen, and in 1625 writes of having been at sea thirty-three years. He cannot, therefore, have taken any part, even as a youth, in the great fight against the Armada, though it was probably the glory of that contest which attracted him to the naval service. That he had adopted the right profession seems clear from the fact that only some ten years later his brilliant services had secured him the command of one of the Queen's ships and a life pension. Although we have no definite record of the fact that his earliest service was performed on the Irish coast, we find among the state papers clear evidence that it must have been so; for it appears that, on some date not stated, and for some specially brilliant service, the nature of which has not been recorded, he had been granted by the Queen (who was far from lavish in according such favours) a pension of six shillings per diem, with five shillings extra for each day on which he should be employed at sea, together with victuals and wages to the value of at least four shillings daily "for his servants and retinewe," all payable out of the revenue of Ireland. From this, one can only infer that he had already come to be regarded as a specially valuable public servant, and as a person of importance. In October, 1601, when a Spanish force occupied Kinsale, "Capt. Button, who had the wafting of the munition and victuals from Dublin, with the Queen's pinnace, *The Moone*, arrived at Cork, and came to the Lord Deputy at camp, signifying that the rest of the shipping was coming," which it did the next day. "He was then sent to bring his ship into the harbour of Kinsale and, with Capt. Ward's ship, to annoy the castle of Kinourran." On the 29th the Spaniards attempted to relieve the castle by boats, but they "were valiantly repelled by Captaine Button's ship." From this time onwards we find frequent mention of Button's name among the State Papers, and it is from this source that we obtain the next recorded event in his life. In a letter from Anthony Rivers to Giacamo Credeto, dated London, March 9, 1602-3,* we read, "One Capt. Newport, with Captaine Button, and some other men-of-warr at sea, are said to have taken two or three frygottes coming from the West Indies, and in them three millions of golde. Some say they are come in at Milford Haven, and others at some port in Ireland. Howsoever to please the Queene, she is made to believe that it is all in harbour in Wales. It will turne to good purpose if it be trew." Although there must, surely, have been some great exaggeration as to the value of these prizes, the record is clear, and their value doubtless great. The next thing we hear of him is that his death had taken

* State Papers. Domestic. Elizabeth. CCLXXVII., 50.

place in "the Indies," a false report which was soon contradicted. But it had for Button this inconvenience, that King James, believing it, had given away the pension which Elizabeth had granted Button to a certain Robert Jannison.* It is gratifying to be able to record that full justice seems to have been done in the matter upon Button's return. We next catch a glimpse of Button at Court in 1604-5, after which we hear practically nothing of him till his departure upon his Arctic voyage early in the spring of 1612, and the officer selected to command an expedition, then regarded as of such great importance, must have been held in high esteem as able and trustworthy. There are in existence two reputed portraits of this now Admiral Sir Thomas Button, one of which is in the Town Hall at Cardiff. The picture however represents a judge of the end of the last century. This portrait is certainly painted over an older one, and bears no resemblence to the other portrait of Button, which has a much more satisfactory history. It is in perfect preservation, was bought of the descendants of the Admiral some seventy years ago, and hangs in the library at Coedriglan Park, near Cardiff. At the top corners are two smaller pictures, that on the left depicting a ship at sea in full sail; that on the right is indistinct. Below the portrait is a reproduction of the fine autograph of Sir Thomas, taken from one of his letters in the Public Record Office.

We now come to Button's Arctic voyage. Be it remembered that Hudson had already sailed thro' a noble straits which led him 600 miles into the huge inland sea, which we now know as Hudson's Bay, and that he had explored its eastern coast and southern extremity (James' Bay), but had seen no land on its western side, where the ardently sought passage should be found, and at the same time almost everybody confidently thought that the passage had actually been discovered, and that it only remained to equip another expedition to explore and sail through it. It was this hopeful and important enterprise which was entrusted to Button. We need no further evidence of the great expectations which were entertained, in reference to Button's voyage, than the fact that, in order to equip and dispatch it, a great trading company was incorporated by Royal Licence, under the name of "The Company of the Merchants of London, discoverers of the North-West Passage," and with the Prince of Wales as its head and "Supreme Protector" with the great Sir Thomas Smythe (Governor of the East India Company) as its governor. Numbering together 288 persons, of whom 25 were peers. That the enterprise was regarded as hazardous may be inferred from the fact that on April 28th, 1612, a few days after Button's departure, a pension of 6/8 a day for life was secured to his wife by patent, with a proviso that his own pension for the same amount should cease. The confidence felt in the success of the voyage is oddly indicated by the fact that Button was provided by King James with a "letter of credence," addressed apparently to the

* State Papers. Ireland. Jas I. Vol. 235. No. 8.

Emperor of Japan, and by the Prince of Wales's encouraging words: "We assume ourself by God's grace that you will not returne without either the good newes of a passage or a sufficient assurance of an impossibility." After the failure of this expedition the same company made several other energetic attempts to discover a passage. That no proper or authorised account of this important voyage was ever published is due to the fact that the company withheld all information which might jeopardise their monopoly. We know from a letter written by Button from Cardiff, Feb. 16th, 1629-30, that his journals still remained in his possession, and that he regretted that they had not been published. Nothing whatever has been heard of them since. I may here say that if they should hereafter come to light in this district, they would have very great interest to myself and others interested in Arctic exploration.

Button sailed from the Thames about the middle of April, 1612, with two ships provisioned for 18 months. One of these was the *Resolution*, which he commanded. He had with him a cousin named Gibbon (one of the Gibbons of Cefn-tre-Payne), and a friend named Hawkridge, both of whom subsequently commanded expeditions with the same object and the same result. According to his instructions he sailed westwards (across what is now known as Hudson's Bay), and was the first to discover its western shore, in about latitude 60° 40' N., which he named "New Wales," in memory of his native land. The particular spot at which he encountered it he named "Hopes Checked," disappointed that he could not sail straight into the Western Ocean and across it to Japan. He then coasted southward, and on August 15th discovered and entered a large river estuary, still called by the name he gave it, "Port Nelson," in memory of the master of one of his vessels who died there. The place was surrounded with forests of spruce and tamarac, and here he decided to winter. The Willow Ptarmigan *(Lagopus albus)* abounded, for it is said they killed 1,800 dozen, with three reindeer and several bears and wolves. Yet with abundant food and constant fires the crew suffered such hardships that many of them died. Button himself was ill all the early part of the winter, but began to mend towards the end of January. On the 21st April the ice began to break up, they caught abundance of fish, and the health of the crews improved. It was not, however, till quite the end of June that the ice allowed their departure, and even then he had to abandon his larger ship, the *Resolution*. He got free July 7th, 1613, and erected a large wooden cross to commemorate his stay there. (This cross was discovered nearly 20 years later by another explorer, Capt. Luke Fox (1631),) and, despite all the hardships undergone, resumed his search for a passage. In his smaller ship, the *Discovery*, he proceeded north for the first time, carefully examining the entire western coastline of Hudson's Bay as far as latitude 65°. Satisfied that no passage westward was to be found there, he turned back homewards. The season was too far advanced for further investigation, and he arrived in England Sept., 1613. Thus ended the first and only Arctic voyage of Sir Thomas Button. It was

a failure, so far as its prime object was concerned; but it was not without result, for the whole of the western and northern coast of Hudson's Bay were, for the first time, explored and made known. Still the disappointment which was felt in England on his return was keen, for his prolonged absence led to the belief that he had passed through the supposed passage into the Pacific, and was returning via Japan. Nevertheless the ardour of the Company was not damped, and another expedition was organised immediately, and dispatched in March, 1614, under Capt. Gibbon, Button's cousin before named. This undertaking proved a miserable failure, and another was dispatched by the tireless company under the command of Capt. Robt. Bylot, who had previously sailed in the same quest under Hudson, Button, and Gibbon successively. He returned unsuccessful.

In the following year, 1616, Bylot and Baffin sailed, under the same auspices, to search Davis' Strait. The voyage led to the discovery of Baffin's Bay, but not of the North-West Passage.

These disappointments did not exhaust the enterprise of the company, for yet another expedition was sent out, under the command of the before-named Captain Hawkridge, probably in 1625, concerning which, however, extremely little is known. Interest now flagged, until, in 1854, the North-West Passage *was* discovered, and found to be impracticable for its expected purpose.

I must now return to Sir Thomas Button, and his life subsequent to his voyage, almost immediately after which, in 1613, he received the appointment of "Admiral of the King's Ships on the Coast of Ireland"; but of his proceedings for the next few years we have very little information of any kind. It is however recorded that, in January, 1614-15, he took a prominent part in the siege of the Castle of Donavegge, the bombardment of which commenced on the 1st of February. In the course of the siege, we hear of Button in person rowing to-and-fro all one night in his long boat to make sure that none of the beleagured should escape by sea. It was probably on account of this, and similar services, that he received the honour of knighthood on August 30th, 1616. It appears that, shortly before July, 1619, a proposition was made by the Lords of the Admiralty to reduce the number of men on board the King's ships serving in the Irish Seas, against which the commanders of the *Answer*, the *Speedwell*, and the *Phœnix* vigorously protested. From Button's statement we gather that his ship, the *Phœnix*, was of 200 tons burden, had 22 pieces of ordnance, and carried 95 men, "besides ye Captaine and his Retinew." Button continues "To confirme what hath beene said, I shall humbly offer to Yr Lops some instances out of my owne experience upon the coaste of Ireland where I now serve. Among many that I have brought to the hands of Justice, and by whose taking the pprietaries have beene repaired of much of their goods lost, some fower years since, I took one Captain Norris in a ship of 300 tonns, 22 pieces of good ordnance, and 70 as good men as the

world could yeeld ; who, after the induring of above a hundred great shotte and many small, at last yeelded, and himself and his chief officers were executed." "Likewise, there were, this last winter, two men-of-warre upon the coast ; and Capn. Ellis and his Vice-Admiral in both shipps were 180 men with pieces and other provisions answerable. The one of them fought with mee from eight in the morning till seven at night ; in which fight the Capn. and divers others were slayne, the rest afterwards yeelding. The master was hanged in Chaynes, and six men executed. Capn. Ellis also yeelded, who was likewise verrie lately executed at Wapping." "Now there coming oftentymes upon that coast shipps of that and more strength, a question may well be asked, whether, if my number had been knowne to them to have been but 60 men, it had been probable I should have had the same success against them ? Nay, rather, whether it had not beene likely they would have attempted somewhat upon the Kinge's shippe, wherein the Kinge's honr. might have suffered." Against these arguments the Lords of the Admiralty advanced very lengthy reasons, but what was ultimately done does not appear ; but, on July 20th, 1620, we find Button instructed to proceed in the *Phœnix* to the Irish coasts "to cleere those seas of Piratts, and secure the Trade and Lives of Merchants, and others His Mat^ie's subjects." He was especially ordered to apprehend "one Burke, an Irishman and notorious Pirat, (who) having manned himself with divers malefactors of that country, doth range upp and downe those coastes, and especially about Berehaven and other places of the West of Ireland, where he taketh, robbeth, and spoyleth all such as he can meete withall, both passengers and merchants, and hath taken a shippe laden with greate quantitie of wynes." Whether or not Button succeeded in capturing this man Burke we do not know, but, on August 23rd, 1620, we find it recorded that a warrant was issued, granting to Sir Thomas Button the sum of £1,452 "as his Mat^ies free gerift for some speciall service by him done to his Mat^ie," and subsequently he was called upon to take a prominent part in the famous expedition against the Algierine pirates, who now maintained a condition of things which we can hardly conceive. They swept the Cornish coasts, infested the Bristol Channel, and made, it is said, their principal rendezvous under Penarth Head. Merchant vessels were obliged to sail in companies for mutual protection, and often had some man-of-war to convoy them. In a contemporary letter we read, "We heare out of the West Countrie of 11 Turkish pirates on the Severne side, that have taken divers prizes and carried away many prisoners from the land, and our Indian merchants remonstrate that they cannot subsist yf they bee no better protected."

It was in the suppression of this piracy that Button's expedition was engaged. It consisted of six of His Majesty's ships, ten merchants' ships and two pinnaces, and sailed from Plymouth, Oct. 12th, 1620. Button himself was rear admiral in the *Rainbow*, of 660 tons, armed with 40 brass cannon, and carrying 250 men. A few pirates were taken, but the expedition was a failure, and in the summer of 1621 was ordered home. Many later expeditions followed, and more than once

inflicted severe chastisement upon the marauders, but their depredations continued till the final conquest of their country by the French in 1830. After his return from Algiers Button resumed his duty of guarding the coasts of Ireland, Wales, and the South-West of England from these and other depredators, but of his doings for the next eighteen months we know nothing; but on April 14th, 1623, Button was ordered to proceed in pursuit of pirates, especially a certain "W. Rosekiner, a Cornish gent, who hath (with him) one Trusse, a notable pyratt, and the rest of his company English; the said W. Rosekiner having pyratically taken two prizes, a Dane laden with copper, lead, and other merchandise, and a Hamburgher bringing sugars, wools, and (as is reported) great store of money." In 1624 piracy is reported on the increase, and Button is promoted to the command of a larger and finer ship, the *Antelope*, with two others. In 1625 a sum of £3,615 13s. 4d. was granted him "for services at sea during 33 years." In this same year his name appears in a Commission to enquire into the state of the Navy, which proves that his services were thought to be of high value. Yet, it is sad to state, that hereabouts a blight seems to have fallen on his fortunes and prospects. Hitherto we have found little recorded of him but constant activity, brilliant services, and frequent honours; but with the accession of Charles I. in 1625, a change seems to have come over his life, although he continued to be actively employed in the service of the king. We now first hear, after 33 years of service at sea, of failing health, of pension, pay and prize-money, long overdue, unpaid, lack of appreciation at head-quarters, and disputes with his officers and others about the ship's accounts and prize-money; all probably due to the deplorable condition into which the navy had fallen during the reign of Charles I. Button had the good of the service too much at heart to be in high favour with the dilatory and dishonest officials at head-quarters, and it is clear that he was not held in high favour there. It was not by any means sufficient in those inglorious days for a public servant faithfully to do his duty, for it was necessary to play the part of an accomplished courtier in its most discreditable sense; and this the plain, straightforward sailor could not do, and it is painful to have to record that a man of Button's ability and service had to pass his declining year in neglect. The following letter (condensed), written by Button from Fulham, Oct. 27th, 1625, to Sir John Coke, then Secretary to the Admiralty, pathetically explains the facts:—

"My own afflictions (are) the greatest that may be—want of health, want of means, and heavy adversaries. I am here tied by necessity and command, not having received my own any time since our return from Algiers. During the 28 years that I have served His Majesty and his predecessors I never did dishonourable or base act. Neither moneys procured orders for, by your honour, my entertainment in the office of the Navy, my pension for my more than miserable voyage to the North-West, my fee in Ireland, nor any other dues to me from His Majesty that I can receive one penny of to relieve me, my wife, and seven

children. Why this course should be held to meward I know not, but from His Majesty and the State I do most confidently say I have not deserved it, etc., etc." During the next five or six declining years of his life the state papers (1625 to 1630) are crowded with letters to, from, and concerning him. Pay, pension, and prize-money are always in arrear, his financial difficulties consequently increasing. Failing health, need of more ordnance and stores, capture of pirates, and the increase of French privateers on the English and Irish coasts, although peace had been concluded with France. In June, 1629, a French man-of-war lay in the Severn, between the Holmes and Bridgewater, and captured a vessel coming to Bristol with lead, the French commander declaring he knew nothing of the conclusion of peace, and did not care if there had been one. Next we hear of Button, under stress of weather and short of provisions, at Cork, where he is in danger of starving, because neither butcher nor baker would give any credit to the King's ships, because, on a previous occasion, they had to wait nine months for payment, and obtained it then only at ruinous expenditure in law costs. It was useless for him to report that the King's service was thus made liable to dishonour, for nothing is clearer than the deplorable corruption of the administration of the period. Early in 1631 he was at his post, tho' every letter to headquarters spoke of his ill-health, and the end was near; yet he could not get "at least a portion of the large arrears of pay."

Early in 1632 the disputes between Sir Thomas and the Victuallers of the Navy became so acute that both were summoned to appear in London, when the matter was temporarily adjusted. From London he went to Newmarket, where the court then was, endeavouring to get payment of long and large arrears, without receiving a penny. Here he fell ill, returned home, and after a tedious journey, which increased his ailment, reached his mother's house at Worlton by the end of May (1632), he managed to reach his own house on Milford Haven, where he anxiously awaited the arrival of his ships, but he does not appear ever to have gone to sea again. In July, Captain Sir Richard Plumleigh was appointed to succeed him as Admiral of the King's ships in the Irish Seas. Button's natural mortification was great, seeing that he had been appointed to that office for life by Royal Warrant, and now for the first time we hear of a prosecution against him for alleged irregularities in the victualling of his ships, which charge, no doubt, had caused his sequestration. He protests against the invasion of his rights as admiral, receives no redress, and, as a last resource, addresses a touching petition to the king, beseeching him to save from ruin himself, his wife, and seven children, by a payment of £358 due to him since 1627, and £311 due to him from 1629. The total amount of arrears, years overdue, being nearly £5,000.

Early in 1634 the long pending action came on, for on 22nd of February the Lords of the Admiralty formulated ten charges against him for neglect of duty, fraudulence, etc.; to these he replied immediately, with much spirit, categorically denying each so fully so

clearly so directly, that a conviction of the flimsiness of the charge results; indeed one cannot avoid the suspicion, that they were brought against him to afford a pretext for withholding his pay and ejecting him from his command. This answering of the charges brought against him is the last recorded act of the admiral's life, for by April he had died, probably of what is commonly called "a broken heart." His eldest son married, firstly, Barbara, daugter and heiress of Rees Meyrick, of Cottrell, and secondly, Florence, daughter of Sir Nicholas Kemeys, of Cefn Mabley. A direct lineal descendant—Button Gwinnett, probably born at Cottrell in 1732—was one of the "signers" of the American Declaration of Independence.

The Meteorology and Kindred Phenomena of 1896.

By FRANKLEN G. EVANS, F.R.A.S., F.R. Met. Soc., &c.

"TIME and tide wait for no man," and we cannot claim exemption from the common lot of humanity; but, borne on the outspread wings of flying time and the heaving bosom of many tides, we have arrived at the conclusion of another year, and the annual retrospect of its meteorological character. The abode of all terrestrial beings has been fixed at the bottom of a gigantic atmospheric sea of great depth, varying density and extreme mobility. Its outer limit may be taken to be about 100 miles or so, but the practical limit is the lowest layer of about 10 miles. If there were no heat or cold this envelope of air would be held firmly down to the earth by the attraction of gravitation in serene tranquility, and wind would be unknown. The existence of differences of temperature alters all this. With the sun acting as a great solar furnace in the equatorial area of the globe, and the ice of the arctic regions performing the part of a great refrigerator, the conditions of expansion, contraction, and constant motion are brought into play. The result is the violent commotion of cyclones and tornadoes that pale into insignificance the mightiest motion of the most tempestuous sea, and the vivifying effect of genial warmth and gentle zephyrs, instead of a cold ocean of stagnant air. Such being the conditions under which we live in our local habitation, we will endeavour to trace out and record some of the atmospheric gyrations of the past year.

The salient features of each month are given in the following summary :—

January was remarkably fine, dry and warm. N.W. winds, of light force, greatly predominated. The barometer was singularly high and

generally steady. The maximum height, 30·95 inches, was attained at 11 p.m. on the 9th; the minimum, 29·54 inches, on the 14th, giving a range of 1·41 inch. The instrument stood above 30 inches on 28 days. The mean degree of humidity was 88—complete saturation being represented by 100. The rainfall was light—only 1 inch, distributed over 9 days. The mean degree of ozone was 6·484. The mean heat was 41·9 degrees—5 degrees above the Greenwich average of 50 years without correction. There was slight frost on eight occasions. The air movements were almost entirely anti-cyclonic. The hazel bloomed on the 30th, the song thrush was first heard on the 17th, and the honey bee first seen on the 18th.

FEBRUARY also was fine, dry and mild. N.W. winds, of light force, again preponderated. The barometer was high and fairly steady; the maximum height, 30·70 inches, was reached on the 1st and 3rd; the minimum, 29·68 inches, on the 20th; range, 1·02 inch. The mercury stood above 30 inches on 25 days. Humidity, 87. Rainfall very light, only ·63 inch, spread over 12 days. Ozone, 6·517. The temperature was high—41·1 degrees—2·4 degrees above the average. There was frost on 12 nights. Air movements deeply anti-cyclonic. The coltsfoot blossomed on the 12th.

MARCH was very mild, but wet. W. winds, sometimes of considerable force, prevailed, with S. in combination. Barometer low and unsteady; maximum height, 30·33 inches, on the 10th; minimum, 28·80 inches, on the 4th; range, 1·53 inch. The reading was below 30 inches on 20 days. Humidity, 81. Rain abundant, 4.11 inches; it fell on 25 days. Ozone, 6·613. Temperature very mild; mean, 46·5 degrees—nearly 5 degrees over average. Slight frost on three occasions. The wood anemone bloomed on the 12th, and blackthorn on the 21st. Wasp first seen on the 14th.

APRIL was a warm, dry, genial month. N.W. winds, of moderate force, held sway. Barometer was very high and steady. Maximum height, 30·52 inches, on the 21st; minimum, 29·82 inches, on the 29th; range, ·70 inch. The record was above 30 inches on 28 days. Humidity, 75. Rainfall light, ·97 inch, divided over 17 days. Mean ozone, 6·100. The temperature was high; mean, 51·4 degrees—5·2 degrees above the average. Frost on one night. The air movements were mainly anti-cyclonic. Garlic hedge mustard blossomed on the 5th, horse chestnut on the 6th, and hawthorn on the 27th. Swallows first seen on the 11th, cuckoo first heard on the 21st, orange-tip butterfly first seen on the 7th, small white on the 17th.

MAY was another very warm, dry, and brilliant month. N.E. winds of no great strength were in the ascendant. Barometer remarkably high and steady; maximum height, 30·54 inches, on the 25th; minimum, 30·03 inches, on the 22nd; range, ·51 inch. The register was above 30 inches on every day. Humidity, 68. Rainfall extremely light, only ·23 inch, distributed over four days. Mean ozone, 4·355. Mean temperature high, 57·4 degrees—4·5 degrees above the average. No frost. A deep anti-cyclone reigned supreme all through the month.

The white oxeye daisy bloomed on the 12th, and dog rose on the 24th. The flycatcher was first seen on the 16th, and meadow brown butterfly on the 10th. The nightingale was not heard here.

JUNE was warm, generally fine, and moderately dry. W. winds, of slight force, with an excess of N. in combination, predominated. Barometer fairly high and steady; maximum height, 30·34 inches, attained on the 29th; minimum, 29·54 inches, on the 9th; range, ·80 inch. The instrument was above 30 inches on 18 days. Mean humidity, 79. Rainfall not heavy, 2·68 inches, distributed over 14 days. Mean ozone, 5·100. Mean heat, 63·8 degrees—4·5 degrees above the average. The air movements were generally anti-cyclonic, with cyclonic alternations. The greater bindweed blossomed on the 12th, and black knapweed on the 13th.

JULY was fine and dry and rather warm. Moderate S.W. winds preponderated. Barometer high and steady; the maximum height, 30·35 inches, on the 17th and 18th; minimum, 29·76 inches, on the 26th, range ·50 inch. The mercury was above 30 inches on 24 days. Humidity, 73. Rainfall scanty—1·39 inch, spread over 11 days. Mean ozone, 3·161. Mean heat, 64·3 degrees—2·5 degrees above average. Air movements mainly anti-cyclonic, with an occasional cyclone. The harebell bloomed on the 9th.

AUGUST was generally fine, fairly warm, with moderate moisture. N.W. winds, sometimes fresh, prevailed. Barometer high and steady; maximum height, 30·36 inches, on the 11th; minimum, 29·77 inches, on the 26th; range, ·59 inch. The reading was above 30 inches on 24 days. Humidity, 70. Rainfall, 2·51 inches, and fell on 13 days. Mean ozone, 4·742. Mean temperature, 60·8 degrees,—slightly above the average. Mixed air movements, chiefly anti-cyclonic.

SEPTEMBER was marked by a total change of the weather which characterised the preceding months. It was cold, wet and stormy, with a violent gale on the 25th. S.W. winds held sway. Barometer low and unsteady; maximum height, 30·48 inches, on the 30th; minimum, 28·79 inches, on the 25th; range, 1·69 inch. The record was below 30 inches on 23 days. Mean humidity, 84. Rainfall very heavy—7·74 inches divided over 25 days. Mean ozone, 5·866. Mean heat, 57·7 degrees—1·1 degree above average. Air movements mainly cyclonic. Ivy blossomed on the 10th.

OCTOBER was cold, wet, and often windy. N.W. winds were in the ascendant. Barometer low and unsteady; maximum height, 30·51 inches, on the 1st; minimum, 29·18 inches, on the 19th; range, 1·33 inch. Register below 30 inches on 24 days. Humidity, 86. Rainfall abundant—4·15 inches, distributed over 21 days. Mean ozone, 5·516. Mean heat, 46·4 degrees—3·8 degrees under average. Frost, 11 times. Air movements mostly cyclonic. Swallows last seen on the 27th.

NOVEMBER was fine, dry and cold. N.E. winds, sometimes fresh in force, predominated. Barometer high and generally steady; maximum height, 30·64 inches, on the 24th; minimum, 29·46 inches, on the 15th;

range, 1·18 inch. The instrument was above 30 inches on 21 days. Humidity, 86. Rainfall light—1·20 inch, spread over nine days. Mean ozone, 5·133. Mean temperature low—40·4 degrees—2·7 degrees below average. Frost on 14 nights. Anti-cyclones ruled the greater part of the month, and cyclonic disturbances to a small extent.

DECEMBER was characterised throughout by extremely wet weather. W. winds, often strong, preponderated. Barometer low and unsteady; maximum height, 30·42 inches, on the 27th; minimum height, 28·60 inches, on the 6th; range, 1·82 inch. The mercury was below 30 inches on 20 days. Mean humidity, 89. Rainfall extremely heavy—9·16 inches, divided over 24 days. Ozone, 5·935. Mean heat, 39·3 degrees—0·5 degree below average. Frost on 10 nights. A series of cyclonic disturbances throughout the month. A violent shock of earthquake occurred at 5.33 on the morning of the 17th, which lasted 15 seconds.

The principal factors in the year's weather are analysed and summarised in the following tables:—

ANALYSIS AND SUMMARY OF THE METEOROLOGY OF 1896.

WIND-DIRECTION, BAROMETER, RAINFALL, &c.; OZONE AND TEMPERATURES.

1896.	More or less Westerly—Days.	More or less Easterly—Days.	Combined with Southerly—Days.	Combined with Northerly—Days.	Barometer below 30 inches—Days.	Mean degree of humidity.	0·01 in. o more of Rain fell—Days.	Rainfall Total—inches.	Maximum fall in 24 hours.	Mean degree of Ozone.	Maximum temperature.	Minimum temperature.	Total range.	Greatest daily range.	Least daily range.	Mean daily range.	Mean of maximum temperatures.	Mean of minimum temperatures.	Mean temperature of the month.	Difference from average of 50 years.
January	16	14	12	16	3	88	9	1·00	0·44	6·484	53	29	24	20	1	9·3	46·7	37·2	41·9	+5·0
February	16	13	13	14	4	87	12	0·63	0·23	6·517	56	26	30	24	2	12·0	47·1	35·1	41·1	+2·4
March	24	7	16	14	20	81	25	4·11	0·44	6·613	61	32	29	26	1	13·8	53·4	39·6	46·5	+4·9
April	17	13	5	23	2	75	17	0·97	0·12	6·100	69	32	37	26	10	18·7	60·8	42·1	51·4	+5·2
May	5	26	6	24	0	68	4	0·23	0·13	4·355	78	37	41	31	16	22·2	68·4	46·3	57·4	+4·5
June	23	6	14	15	12	79	14	2·68	0·64	5·100	85	47	38	30	11	20·9	74·3	53·3	63·8	+4·5
July	23	7	18	9	7	73	11	1·39	0·40	3·161	86	45	41	33	14	23·3	76·0	52·6	64·3	+2·5
August	18	12	9	21	7	70	13	2·51	0·73	4·742	80	43	37	30	7	21·5	71·6	50·1	60·8	—0·4
September	21	8	19	11	23	84	25	7·74	1·33	5·866	71	39	32	27	5	15·8	65·6	49·8	57·7	+1·1
October	20	11	12	18	24	86	21	4·15	0·82	5·516	70	29	41	24	8	16·9	54·9	38·0	46·4	—3·8
November	13	17	6	22	9	86	9	1·20	0·76	5·133	52	25	27	24	2	12·3	46·6	34·3	40·4	—2·7
December	19	11	14	15	20	89	24	9·16	0·95	5·935	52	24	28	20	6	11·0	44·8	33·8	39·3	—0·5
Totals and Means	215	145	144	202	131	80	184	35·77	7·01	5·460	86	24	62	33	1	16·5	59·0	44·0	51·0	+2·0

In this table the first two columns give the number of days on which the winds were westerly and easterly respectively. The third and fourth columns show the proportion in which southerly and northerly currents were combined with the other two quarters. The figures give a large excess of westerly and northerly directions.

BAROMETER. Atmospheric pressure in 1896 was remarkably high and steady. The maximum height, 30·95 inches, was attained on the 9th of January, at 11 p.m. This is the highest reading in my record of 31 years, but it was nearly equalled on January 18th, 1882, when 30·94 inches was registered. The lowest reading was 28·60 inches on December 6th, giving a wide limit of oscillation and a total range of 2·35 inches. The instrument stood above 30 inches on 235 days.

HUMIDITY was highest in December, when the mean degree was 89, and lowest in May, when the mean degree was 68. The mean degree for the year was 80, complete saturation being represented by 100.

RAINFALL in 1896 displayed the same fitful and erratic character which has distinguished it, more or less, for many years past. The greater part of the year was marked by extreme dryness, and it added yet another to the many droughts that have been so distinguishing a feature of the last 10 years. The first was 1887 (the Jubilee year), followed by 1893, 1895 and 1896, which was the most severe of them all in the first half of the year, though the balance was redressed by the excessive rains of the autumn. Other years showed some deficiency, so that the 10 years between the Jubilee and the Diamond Jubilee had an unusual amount of "Queen's weather." The driest months were January, February, April, May, July and November, and the wettest were March, September, October and December. The total rainfall at Llwynarthan was 35·77 inches, which is equal to 3,612 tons, or upwards of 14,940 hogsheads to an acre. This total is rather less than the average of the previous 10 years. The number of wet days was 184. The rainfall for 1896 in the Society's Field is shown in the following table, arranged in the order of elevation above sea level :—

1896.	Feet Above Sea Level.	Inches.
C. H. Priestley, Taff Fawr	1,328	66·47
G. A. Lundie, Bargoed	1,237	40·64
Wm. Jones, Castell Nos, Pontypridd	1,110	61·22
George Palmer, Penwyllt, Brecon	1,108	60·51
Edward Martin, Gwernllyn, Dowlais	1,035	44·50
G. A. Brown, Tredegar	1,024	51·06
Forster Brown & Rees, Glyncorrwg	717	78·75
W. T. Lewis (Sir, Bart.), Treherbert	670	74·47
E. J. Lowe, F.R.S., Shirenewton, Chepstow	530	33·57
W. T. Lewis (Sir, Bart.), Aberdare	431	50·04
Evan Jones, Aberdare	430	47·35
W. E. C. Curre, Itton Court, Mon.	370	31·02
T. Hutchins, Gwernyfed Park, Three Cocks, Brecon ...	350	27·87
F. J. Mitchell, Llanfrechfa	326	34·63

1896.	Feet Above Sea Level.	Inches.
Tudor Owen, Ash Hall	315	40·68
H. A. Lewis (Miss), Tan-yr-allt, Ystalyfera	300	57·65
Wm. Jones, Reservoir, Pontypridd	300	50·20
Henry Clay, Piercefield, Chepstow	300	28·18
H. M. Jackson (Sir, Bart.), Llantilio Court, Mon.	207	26·17
Edwin C. Pole, Neath	204	42·34
James Bell, C.E., Barry...	191	33·92
Lord Llangattock, The Hendre, Mon.	176	24·63
Godfrey Clark, Talygarn, Glam.	150	50·25
C. H. Priestley, Lisvane	135	31·38
O. H. Jones, Fonmon Castle, Glam.	130	40·17
C. H. Priestley, Cogan	121	34·11
Iltyd Nicholl, The Ham, Cowbridge	96	30·11
Franklen G. Evans, F.R.A.S., Llwynarthan...	72	35·77
George Evans, The Rest, Porthcawl	60	27·12
C. H. Priestley, Ely	53	39·19
A. Pettigrew, Castle Gardens, Cardiff...	39	36·34
Togarmah Rees, C.E., Porton, Mon.	26	22·94

The rainfall over the whole district bears a strong family likeness to that of the previous year, and the remarks I then made will apply, to a great extent, to 1896. It was a year of wide-spread and severe drought, but was more intense than in any year of the previous ten; but the excessive rains of October and December mask the scantiness of the totals in the first eight months of the year. The rainfall followed the usual rule of increase in proportion to elevation above sea-level and westerly position, subject to some modification from local peculiarities. The highest total was again that of Glyncorrwg, followed closely by that of Treherbert. Taff Fawr was less than last year's record. The lowest record—22·94 inches—was that of Porton, Goldcliff, Mon., the lowest place in elevation above sea-level, and also eastward in position. The next is The Hendre, also easterly, 24·63 inches, followed by Porthcawl Rest, 27·12 inches. The Ham is comparatively high, 30·10 inches.

The best thanks of the Society are again due to the zealous band of workers who continue their labour year after year.

Ozone was highly developed, and reached a mean degree of 5·460.

Temperature in 1896 was very high until the autumn, when a cold wave set in, which reduced, but did not neutralise, the general excess. The maximum readings of the thermometer in the shade, 4 feet above ground, was 86 degrees, on July 20th, and the lowest night record was 24 degrees, on December 18th, showing a range of 62 degrees. The greatest daily range was 33 degrees, on July 20th; the least variation, one degree, on three occasions, and the mean daily range was 16·5 degrees. The mean of the maximum temperatures was 59 degrees, and of the minimum 44 degrees. The mean heat of the year was

51 degrees, which is two degrees above the Greenwich average of 50 years without correction.

THE YEAR 1896. The summary of the months contained the hard framework or bony skeleton of the annual record, but this requires to be clothed with softer and more rounded outlines to show the procession of the seasons, and the glorious pageant of the year. It had some points of similarity, and others of extreme contrast with its immediate predecessor, 1895. That year was memorable for the extraordinary frost that prevailed from December 30th, 1894, to March 18th, 1895, and was the second in severity in this century, as it was only surpassed by that of 1814, and that mainly by the depth and duration of snow. It was unprecedented in the destruction of water and gas pipes, which hardly existed in the early part of the century. The frost was accompanied also by great drought, which continued after it had broken up, and held firmly on through the hot weather of the spring and summer months. The commencement of 1896 differed extremely from that of 1895. It was as remarkable for warmth as the latter had been for cold, yet they were similar in dryness, and the fine anti-cyclonic weather that distinguished both periods. This was a marked peculiarity of the early months of 1896,—great mildness and anti-cyclonic conditions. At all seasons of the year anti-cyclones are usually accompanied by calm, fine weather. In the summer it is warm, but in the winter generally cold, often severely so, and this makes the period under consideration very remarkable. The explanation is to be sought in the place of origin of the anti-cyclones, as they are sometimes formed over the Atlantic Ocean in comparatively mild surroundings, and at other times in icy northern and even polar regions. By way of illustration and contrast with the anti-cyclones of the early months of 1896, and their mild and genial influence, I recall one of a remarkable and very opposite character, which occurred some years ago, in December, during the time of the Smithfield Fat Cattle Show. A very deep anti-cyclone pressed heavily down from the north over this country, producing great calm, intense frost, and very dense fog, which made breathing to man and beast almost impossible. In the Cattle Show the effect was most disastrous, the over-fed animals were almost suffocated, and in some inflammation of the lungs ensued; some died, and many others were only saved by being taken out of London as soon as possible. The mild weather of 1896 became very warm with advancing season, and lasted almost continuously until September, but the closing months of the year were decidedly cold. A gale of an unusually violent character occurred on the 25th of September, and it was a typical illustration of the extreme violence that sometimes marks the latter part of a cyclone—that is, when the centre of the storm has passed, and the wind assumes a more northerly direction. On this occasion, a gale had been blowing from the S.W., and when the centre was passing the wind lulled, and afterwards, at 10 a.m., it shifted to N.N.W., and began to blow again with great violence, and continued until 8 p.m. The maximum force was reached about 2.30 to 3 o'clock,

when it blew with almost hurricane strength. This gale illustrates the old couplet in reference to the increase of force of cyclonic storms that often happens after the centre has passed, and the wind shifts, and the barometer begins to rise :—

"First rise after low
Foretells stronger blow."

The damage done by the storm in North and South Wales was very great, and trees were destroyed by thousands. The injury done to telegraph posts and wires was very severe and extensive, and for a day or two afterwards no messages could be sent. Railway traffic too was much impeded. There was some loss of life. A landslip occurred above Pontypridd, and a portion of the canal was damaged. There were many disasters at sea. Another storm happened on October 9th, which was extremely severe at Brighton and surrounding district, when the old Chain Pier was washed away. Llanelly also suffered seriously; at Ferryside the sea-wall was broken down and the Great Western Railway submerged. At Porthcawl the sea rose to an unusual height, and the esplanade and sea-wall were injured. With the advent of November the weather completely changed, and we had a very fine month. December was the wettest period of the year, and altogether miserable.

AGRICULTURE in 1896 was highly favoured by the mild, open winter that prevailed, which economised to the utmost the stores of food—not too abundant—and it enabled the farmer to get on with his field operations, and at this time the light rainfall was no detriment. March, with its abundant downpour also was advantageous, and all crops were in good condition. All live stock, too, did extremely well under the mild, open conditions, and abundance of pasture. Later on the weather got too dry in many localities, to the detriment of the hay crop, which was generally scanty. In fact, the drought was the most serious we have had in the past 10 years—a period most prolific of dry seasons—and the agriculturist saw his hopes much blighted, as they have so often been of late years. Oats and, in a smaller degree, barley suffered much, but wheat, according to its wont, bore the parching conditions well, and the yield was one of the best on record. In addition to the good crop, the price of wheat advanced steadily, and near the end of the year it reached 33s. 4d. a quarter, which is the highest point touched for a long period. Potatoes were not so good as usual, and root crops were unable to thrive under the arid state of the soil. The rains towards the close of the year were generally beneficial, and green food became very abundant, but the downpour in December was far in excess of the land's requirements. In some localities, particularly in the North and Scotland, where crops were late, the September rains were very detrimental to the harvest, but in the South the fields were already cleared. On the whole, agriculture is in a more hopeful condition, and recent legislation must have a beneficial influence on its prospects.

HEALTH AND LIFE. The brilliantly fine, mild, and dry weather that continued so persistently for many months in 1896, greatly conduced to a low rate of mortality and the maintenance of a high degree of health and comfort in the population. People lived very much out of doors and took constant and varied exercise, which, with the abundance of fresh air, favoured a strong tone of vitality. The chief drawback to the warmth and drought was a deficiency in water supply that was very severe in many districts, and led to much inconvenience and occasionally to some sickness, but not to a serious extent. The intensity of the drought was well shown by the fact that a crop of hay was gathered off the Dolygaer Reservoir above Merthyr Tydfil. Even in Cardiff, where the water supply is generally so satisfactory and obtained from such a pure source, some inconvenience was felt, owing to the water, from long storage and deficient ventilation, becoming contaminated and unfit for use. But this was only a partial and very temporary condition, and did not lead to any serious consequences. Dr. Walford, in his Annual Report for 1896, refers to the high birth rate of Cardiff, 38·3 per 1,000, which exceeds that of other large towns, and to the satisfactory position of the death rate, 18·8 per 1,000 living. What a contrast this presents to the state of Cardiff before the establishment of the main drainage system and of the water works about the same date, when, for a time, the deaths actually exceeded the births. This shows the vast importance of sanitary arrangements, and the advantages that may be expected from the proposed institution of a health department at the University College to inculcate the true principles and promote the practice of sanitary science.

EARTHQUAKES. There were many shocks of earthquake in 1896, and two or more in this country. The principal one in these islands took place on the morning of December 17th, and was wide-spread and severe. The shock occurred at 5.35, and consisted of a rushing sound that lasted for about five seconds, and an oscillation of ten seconds. Beyond the vibration nothing happened here, there was no displacement of furniture, breaking of crockery, or ringing of bells, but only a shock. The area affected was unusually large, extending through Middlesex, Lancashire, Herefordshire, Worcestershire, Gloucestershire, Shropshire, and the whole of Wales. It was most severe at Hereford, where the whole of the pinnacles of St. Nicholas Church, and part of those of the cathedral were thrown down, and a poor woman was killed by fright.

RŒNTGEN RAYS. The new photography or rather skiagraphy has gone on improving in development since it was first discovered, and in range of utility. The bony skeleton as well as the solid internal organs of the body have been brought out with far greater clearness, and the whole arterial system when injected with a red fluid that becomes opaque and solid has been well shown. Prof. Maxwell, fifteen years ago, formulated a beautiful theory that there must be at least one ray besides those then known, and this was afterwards demonstrated by the late Prof. Hertz, who added to our list the electro-magnetic ray. It seems highly probable that the X rays exist in nature. Dr. Dawson

Turner has found that if glow worms be allowed to crawl over the surface of a photographic plate, wrapped in an opaque cover, the trails of these animals leave an impression on the plate which is capable of being developed in the ordinary way. Another observer has discovered that the sexual sense of certain beetles can be excited through partitions that cannot transmit light. It is believed that the human eye is sensitive to these rays in the extreme margin of the retina. Amongst the lower invertebrates there are numerous sense organs, the use of which has not been explained, and which have for some time past suggested the possibility of the existence of another sense not possessed by the higher animals.

Astronomy in 1896 presented some features of interest, though nothing of a very important character took place beyond the usual recurrence of solar and stellar phenomena.

Eclipses. We are passing through a very barren period in these striking events, and have to make the most of opportunities presenting themselves in any part of the world to make up for the dearth of such occurrences in our own country. The great total solar eclipse of August 9th was looked forward to with much interest, and numerous well-equipped scientific expeditions were fitted out to various localities along the line of totality to gather new facts by observation and photography. Many trips of a more popular kind were also organized, and the eclipse was paraded as an additional attraction to a pleasant summer sail. The weather, unfortunately, turned out very unpropitious at many of the stations, and some of the most promising. The central line of totality passed from the extreme north of Norway, across Nova Zembla, Siberia and Manchuria, to Yesso, in Japan. The expedition to Bodsö, under the auspices of the British Astronomical Association, failed entirely owing to a cloudy sky. At Nova Zembla, the party taken out by Sir George Baden Powell in his yacht were quite successful, the weather being very clear throughout, and all the required observations were most satisfactorily obtained. The Russian expedition to North Finland also experienced magnificent weather, and were enabled to obtain ten good photographs of the corona. At Bolö the totality was well seen, and the corona was observed to extend to the length of the sun's diameter towards the north-east, and to the south-east to about half the diameter; to the north it was very slight indeed. On the south-west edge of the sun a large red spot was visible until totality had entirely ceased. Another observer noted two small spots on the east side. It was remarked that the obscurity during totality enabled Jupiter, Venus, Mars and Regulus to be seen. It appears that the corona in 1896 was of a character intermediate between that of years of maximum and minimum sunspots. Prof. Kaulbars, one of the Russian observers in Finland, reports that the corona was unusually large. An observer, stationed on a mountain near Bodö, noted three red prominences; one of them being visible to the naked eye. Although so many expeditions failed, we have reason to hope that enough has been secured to increase our knowledge of the corona.

Leap Year. There is a certain interest attaching to 1896, as it is the last leap year until 1904, an interval of eight years. We commonly speak of the length of the annual solar period as 365 days and 6 hours, and if this were the exact duration the matter would be simple, and the addition of one day every four years would correct all error. The odd 6 hours, however, is inaccurate, and the true figures are 5 hours, 48 minutes, and 46 and a decimal seconds, consequently the error is over corrected, and the added day has occasionally to be omitted. This will happen in 1900, which will not be a bissextile year, although divisible by 4. The amount by which the addition of one day in four years exceeds the proper correction is nearly three days in 400 years, so that by this arrangement there are only 97 intercalations in 400 years, instead of 100, so that leap year occurs every four years, but is omitted every hundred years except the fourth hundred. For example, it will be left out in 1900, 2100, 2200, and 2300; but retained in 2000, 2400, and 2800. Inattention in the past to the cumulative effect of this small difference led to a serious error in the calendars which, owing to prejudice, it was difficult to overcome. In the 16th century, by which time the over-correction amounted to more than 10 days, the vernal equinox falling on March 11th instead of March 21st. Pope Gregory undertook to correct it, and so instituted what is called the New Style. In Russia the Old Style is still retained. At a much earlier period the year was taken to contain 365 days only, which resulted in a very large error as time went on. It is said that the inhabitants of ancient Thebes were the first to discover this, and in the time of Julius Cæsar the calendar was so confused that he called in the aid of the Egyptian astronomer, Sosigenes, to reform it. He recommended that one day every four years should be added by reckoning the 6th day before the kalends of March twice—hence the term "bissextile." With us the additional day was added to February. This arrangement seemed satisfactory until it was discovered that one day in four years was too much, and a further correction had to be adopted as before described, and this was made law by an Act passed in the reign of George II. Persons born on February 29th have a birthday only once in four years, and now eight years must elapse between the anniversaries. Ladies are supposed to take the initiative in matters matrimonial in leap year, but now the privilege must be suspended for eight years, but it is not to be supposed that this will lead to any great reduction in the marriage rate.

Meteors. The near approach of the great meteoric shower, which will recur on the nights of November 13th and 14th, 1899, renders it desirable to carefully watch for the gradual appearance of smaller displays in the years immediately preceding that date, and which lead up to the grand culminating spectacle. Many people can remember the last recurrence of this splendid star shower that took place in 1866, and excited so much wonder and interest. These meteors are called Leonids because their radiant point is in the constellation Leo. After 1866 the spectacle returned annually to a gradually decreasing extent until 1873, when it practically ceased. It was then anticipated that

there would be a recurrence of the shower in increasing force as 1899 drew near, as a foretaste of the full display. The orbit of this meteor stream is believed to be elliptical, and similar to, but not quite identical with, that of the earth, and that the stream is much thicker in some parts than others, in fact, rather a series of groups than a continuous line. The earth's orbit intersects that of the meteors in certain parts, and when that occurs where the stream is broad and dense, an abundant shower takes place, thousands may be counted by a single observer, and the aggregate fall must be enormous, but where it is sparse and thin few or none may appear. In the regular cycle of events this happens at certain fixed periods, which punctually recur very much as a comet of short period returns with reasonable regularity. In some cases, as in comets that have not elliptical orbits, and therefore do not return, there is every probability that there are associated meteor streams which occasion casual showers. The nucleus of many comets is composed of meteors, and some of them are associated with particular star showers, such as the bright comet of 1862 with the August shower, the Temple comet of 1866 with the fall of November 14th, and Biela's comet with that of November 27th, and as comets are dispersed they become component parts of the meteor stream to which they belong. All meteoric bodies have a similar nature and origin, but they may be divided for convenience into two great classes—1st, those which are small and fall in showers, and which might be called—to coin a word—"epistellate"; and 2nd, large masses that fall singly and are termed "sporadic." Of the former the known meteor showers are examples, and of the latter numerous interesting instances are recorded in the course of centuries. A remarkable example occurred at Madrid in February, 1896. At 9.30 o'clock on the morning of the 10th, an aerolite of considerable size exploded in the air about 21 miles high above Madrid. It appeared as a white cloud bordered with red, which was travelling at a great rate, leaving behind it a train of fine light dust. The explosion was so violent that walls were shaken down, windows broken, and a general panic ensued that caused injury and loss of life. It was seen and heard for many miles round, and at Burgos several large fragments were picked up. In other places pieces were found, they were of a greyish colour and similar to other cases recorded. This aerolite was noteworthy for the great atmospheric disturbance caused by it, and the large area over which it was felt. Livy tells of a shower of stones that fell in the Alban Mountain 654 B.C. About 400 years ago, a stone, which is still to be seen in the village church of Ennisheim, Alsace, fell from the sky. In Normandy, in April, 1803, an extraordinary aerolite occurred, which resulted in a shower of stones that was distributed over an oval area seven miles long by three broad, and about 3,000 specimens were collected, some weighing 17 pounds. These examples will suffice to show the general nature of the phenomena. The stones that fall in meteoric showers are generally small, and are entirely burnt up and disintegrated in their rapid passage through the air, and leave only dust

behind their brief and brilliant streams of light. For several years past the night of the 13th and 14th of November has been cloudy, and so no observations could be taken. This was the case here last November also, and at most other places, although astronomers were on the tip toe of expectation to note any stray meteor. At Dublin, however, there were occasional breaks in the cloud canopy, and partial success was obtained. Prof. Arthur Rambaut kept watch for some hours and a great many meteors were seen, some of a yellow colour. An attempt was made to photograph them, but without success. During the next two years we may hope for better fortune and to obtain good miniature rehearsals of the great event. It will be well, therefore, to keep a sharp look out, and in order to enlist the sympathy and secure the services of the bright eyes of the fair in the pursuit, I will add the following lines, for which, however, I am not responsible :—

" For every shooting star he claimed a kiss.
She, seeming coy, at first demurred to this,
But he, persisting, would not be denied,
When he at length a flying meteor spied.
And so, as evening grew a pace, their eyes
Oft scanned the glittering aspect of the skies,
And when a darting star caught either's sight,
A sound of kissing broke upon the night.
And so it came to pass anon that she
Looked for a shooting star as much as he.
Nay, if by chance a star escaped his view,
She called his wandering fancy to it too.
When meteors failed to shoot across the sky
She pointed out a passing fire-fly.
And, ever taxing her ingenious mind,
Her ready wit enabled her to find
More shooting stars in three short fleeting hours
Than would compose whole meteoric showers.
But when she did her last pretext exhaust,
And was about to yield her cause as lost,
She saw a switchman's lantern circling swing,
And got the youth down to a steady thing."

Looking Back. During living memory extraordinary developments have taken place in the great science of astronomy. Telescopes and other appliances have been vastly improved, the spectroscope invented, and photography harnessed to the car of its progress. But if we cast our eyes back to the primitive ages of the world, it is difficult to take in and realise the aspect and nature of the heavens as seen and interpreted by early man. The "crystal vault of heaven," as it was termed, excited his deepest interest. It was so named in earliest times from a belief that the firmament was made of many layers of glass enclosing each other, and perfectly solid, and the stars were supposed to be firmly fixed to the crystal sphere, but the planets were free and unfettered. This opinion was held by the fathers of the church in the middle ages, and, according to Humboldt, it still holds ground in some of the monasteries of South Europe. Meteoric stones with vitreous crusts were not thought to be portions of the fallen stone

itself, but fragments of the crystal vault broken by its fall. Then, believing the earth to be fixed, and the seven planets—so-called from *planeta*, a wanderer—and consisting of five true planets—Mercury, Venus, Mars, Jupiter and Saturn—and the Sun and Moon, they grasped the apparent but missed the actual truth. The Sun and Moon were the most obvious, the former being the ruler of the day and great source of light and heat, and the latter the ruler of the night, and now familiarly known in rural circles as the "parish lantern." The fixed stars were wholly misunderstood, but were supposed to be subservient to the interests of mankind, and to preside over his destinies. It was from this belief that the so-called science of astrology arose, which for centuries swayed the minds of men, and its effects still linger in our modes of speech and forms of expression, and the name itself is a hindrance and a stumbling block. When a true science of the stars was gradually evolved out of the ruins of this superstitious craze, just as chemistry arose out of the ashes of Alchemy, it was called astronomy—law of the stars—because the far more comprehensive term astrology—meaning law, motion, nature and composition—had already been appropriated and misapplied, so the inferior name had to be accepted. From the standpoint of a fixed earth, and a firmament of fixed stars as a background, the other celestial bodies were seen to be moving in proper order and justified the name of planets, and the number seven had its influence as it is supposed to be lucky in a mundane and scriptural sense. Astrology influenced names and even language. The stars were consulted before undertaking important enterprises, and the Greek and Latin classics abound in references to this practice. Hence to the phrases "unlucky star," "ill-starred," consider *con* and *sidus* disaster, bad star, or misfortune. "The stars in their courses," "the opposing influence of the stars," &c. Amongst many European nations the seven planets seem to have determined the number of the days of the week, which, also, were mainly named after them. The Incas of Peru, learned in many ways, had a week, according to Prescott, of 7, 9, or 10 days, not certain which. The Aztecs, of Mexico, one of five days. Amongst the Latins the sun, being the most important planet, gave its name to the first day, and the moon to the second. The last day was called after the most distant planet, but the rest do not follow any definite order. The French, as might be expected, adopt the same system. In English the first, second and last follow the Latin order, but the third, fourth, fifth and sixth are named after heathen deities of similar meaning—Tuesday, from Tuesco, Saxon ; Wednesday, from Wodin, chief god of Scandinavia ; Thursday, from Thor, Scandinavian deity ; and Friday, from Friga, wife of Wodin. Saturday may have come from Seter just as well as from Saturn. When Pope Gregory sent St. Augustine to England, he impressed upon him the necessity of respecting the old appellation of week days, &c., and it is singular how they came to be mixed up with Latin. The Welsh names of the days are exactly equivalent to the Latin—Dydd Sul, Dydd Llun, Dydd Mawrth, Dydd Mercher, Dydd

Iau, Dydd Gwener, Dydd Sadwrn. The first dawn of astronomical science carries back to Babylon and the Chaldeans, and they appear to have known, if they did not invent, the constellations. One of the earliest reports of an astronomical event is an eclipse of the moon 720 B.C., recorded by Ptolemy. The Egyptians, too, were familiar with the science, and the Pyramids, nothwithstanding their high antiquity, appear to have been built on astronomical lines which are only now being explained by modern experts. The calm occupation of the Chaldean shepherds was favourable to contemplation, and the star-spangled sky was to them a timepiece to regulate the watches of the night, as it is at the present day in the vast prairies and cattle ranches of our colonies. This thoughtful habit of the shepherds' minds, as they tended their flocks by night, was most appropriately utilised by the Angel to announce the tidings of great joy on the first Christmas morning.

Conclusion. If this were all I had to say I should be well content, but I regret that I must now add a few words of farewell to the readers who have been accustomed to wander with me through the interesting meteorological events of each succeeding year. For 31 years I have taken and kept a careful record of the observations that make up the sum of the year's weather. This has involved the expenditure of a large amount of time and labour, and some sacrifice of convenience. The period has now arrived when I should claim relief and rest, and delegate the work to other hands. A close observation of Nature has a very soothing effect on the mind, and tends to make people reflect on their own place in the physical and spiritual worlds, and to ask themselves whence they came and whither they are going. In old patriarchal days, when Isaac went out to meditate in the field at eventide, he probably pondered over the mysteries of existence and his own part and lot in the phenomena of the world. It seems natural to meditate in the evening hour, when the business and turmoil of the day is done, and similarly also in the twilight of life, when it is toward evening and the day is far spent, we are prone to look upon the long day that we call life and forward to the coming dawn of perpetual day. In the twilight of days and in the evening of life calm and peaceful thoughts occupy the mind, and we realise how time is floating away, and we come to the verge of the better land and the haven of eternal rest.

How many a thought, at that sweet hour,
Steals o'er the heart with thrilling power;—
The spirit heaves its earthly home,
And longs for unknown worlds to roam.
And we must hope that gems like these,
Gliding on to Eternal Seas,
Will shine again with heav'nly ray
When Time shall cease to float away.

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD.

No. of Gauge on Map.....	C. H. Priestley, No. 1 Reservoir, Cwm Taff Fawr, Brecknockshire. 5 inches. 1 foot. 1,328 feet.				G. A. Lundie, Cwm Bargoed, Glamorgan. 5 inches. 1 foot. 1,237 feet approximately.				W. Jones, Castell Nos Reservoir, Mardy, Rhondda, Glamorgan. 5 inches. 1 foot. 1,110 feet.			
Rain Gauge { Diameter of Funnel..... Height { Above Ground... on Top { Above Sea Level (As levelled from Ordnance B.M.)												
1896.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	3·75	1·33	24th	16	1·79	0·50	24 & 14	8	3·27	1·01	24th	12
February	1·23	0·37	29th	11	1·23	0·44	8th	9	2·19	0·91	8th	11
March	8·57	0·77	7th	28	4·76	0·50	7th	24	7·83	0·92	7th	25
April	2·03	0·35	10th	17	0·84	0·17	13th	9	2·00	0·42	10th	14
May	0·16	0·06	21st	4	0·59	0·52	13th	3	0·04	0·04	21st	1
June	3·71	0·99	9th	17	1·79	0·36	16th	13	3·10	0·78	17th	15
July	4·07	1·32	8th	14	3·04	0·86	24th	10	3·79	0·92	25th	12
August	4·15	1·25	29th	19	2·46	0·61	19th	14	3·83	0·87	18th	12
September	13·01	2·02	17th	27	9·06	1·68	24th	24	12·56	2·11	24th	25
October...	8·99	1·58	7th	23	5·57	1·23	6th	19	7·52	1·45	6th	15
November	2.42	0·57	14 & 15	15	1·38	1.04	14 & 15	7	2·00	0·83	14th	6
December	14·38	1·85	27th	29	8.13	1·02	4th	22	13·09	1·48	27th	24
Total...	66·47			220	40·64			162	61·22			172

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....													
Rain Gauge: Diameter of Funnel.....													
Rain Gauge: Height above Ground...													
Rain Gauge: on Top above Sea Level (As levelled from Ordnance B.M.)													
	Geo. Palmer, Penwyllt, Brecon. 5 inches. 1 foot. 1,108 feet.				R. C. Harrison, "Gwernllwyn," Dowlais, Glamorgan. 5 inches. 1 foot 9 inches. 1,035 feet.				Geo. Arthur Brown, The Willows, Tredegar, Monmouthshire. 8 inches, 1 feet. 1,024 feet.			
1896.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	3·52	0·98	24th	11	1·82	0·54	24th	16	2·27	0·70	24th	14
February	2·23	1·14	8th	6	1·33	0·42	8th	10	1·56	0·36	29th	12
March	8·01	1·13	7th	25	6·05	0·70	7th	26	6·84	0·55	2nd	27
April	2·17	0·44	13th	9	1·06	0·21	10th	15	1·28	0·28	16th	13
May	0·14	0·14	21st	1	0·14	0·07	13th	3	0·92	0·80	13th	3
June	3·21	0·82	9th	13	2·24	0·53	9th	14	2·44	0·55	9th	12
July	3·64	0·83	25th	11	2·92	0·93	25th	13	2·81	0·73	24th	12
August	4·48	0·85	24th	13	2·50	0·45	19th	14	2·96	0·59	19th	14
September	10.51	1·74	17th	21	9·13	1·95	24th	26	10·01	1·67	29th	26
October...	7·44	1·36	6th	19	6·00	1·08	6th	20	6·55	1·32	6th	21
November	2·29	0·71	14th	5	1·60	0·76	14th	11	1.68	0·77	14th	8
December	12·87	1·17	27th	21	9·71	0·94	4th	25	11·74	1·36	4th	23
Total...	60·51			155	44·50			193	51·06			185

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....		FORSTER BROWN & REES, Glyncorrwg, Glamorgan.				SIR W. THOMAS LEWIS, BART., Treherbert, Glamorgan.				E. J. LOWE, F.R.S. Shirenewton Hall, Monmouthshire,			
Rain Gauge	Diameter of Funnel.....	5 inches.				5 inches.				8 inches.			
	Height above Ground...	4 feet 6 inches.				1 foot.				1 foot.			
	on Top above Sea Level	717 feet.				670 feet.				531 feet.			
(As levelled from Ordnance B.M.)													
1896.		Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
		Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	... ...	4·87	1·76	25th	16	3·90	1·41	24th	16	1·165	0·520	24th	15
February	... ...	2·53	1·58	9th	12	2·31	1·27	8th	9	0·658	0·224	8th	10
March	... ...	11·25	1·02	8th	29	9·50	1.24	19th	26	4·258	0·625	20th	26
April	... ...	2·74	0·65	11th	16	2·68	0·56	27th	16	0·960	0·206	13th	14
May	... ...	0·12	0·10	22nd	3	0·09	0·07	21st	2	0·295	0·136	21st	2
June	... ...	3·12	0·64	17th	14	2·95	0.90	16th	17	2·221	0·402	8th	15
July	... ...	4·60	1·06	9th	14	4·88	1·05	24th	14	1·400	0·494	23rd	8
August	... ...	8·21	2·15	3rd	19	4·91	1·21	29th	14	1·784	0·382	19th	14
September	... ...	12·14	2·14	18th	26	13·22	2·38	24th	25	8·787	1·145	4th	26
October	... ...	9·20	1·38	7th	18	9·38	1·82	6th	19	5·003	0·980	6th	24
November	... ...	2·81	1·28	15th	8	2·82	1·51	14th	10	1·169	0·722	14th	10
December	... ...	17·16	2·44	28th	26	17·83	1·70	10th	25	5·875	0·874	17th	23
Total	... ...	78·75	16·20		201	74·47	15·12		193	33·575			187

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	Sir W. Thomas Lewis, Bart., The Mardy, Aberdare, Glamorgan. 5 inches. 2 feet. 431 feet.				Evan Jones, Abernant, Aberdare, Glamorgan. 5 inches. 4 feet 6 inches. 425 feet.				Edward Curre, Itton Court, Chepstow, Monmouthshire. 8 inches. 4 feet 6 inches. 390 feet.			
Rain Gauge { Diameter of Funnel..... Height { Above Ground... on Top { Above Sea Level (As levelled from Ordnance B.M.)												
1896.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January ...	1·84	0·65	24th	13	1·52	0·66	25th	8	1·035	...	...	12
February ...	1·23	0·33	8th	11	1·34	0·61	9th	8	0·533	...	...	10
March ...	7·26	0·72	2nd	27	7·52	0·78	20th	24	3·977	...	...	23
April ...	1·17	0·22	10th	16	1·10	0·22	11th	10	0·536	...	...	10
May ...	0·16	0·06	21st	4	0·02	0·02	22nd	1	0·180	...	...	2
June ...	2·02	0·42	16th	15	1·86	0·31	20th	11	2·290	...	...	12
July ...	3·28	1·03	24th	13	1·44	0·40	26th	9	1·470	...	...	9
August ...	3·26	0·49	19th	21	3·49	0·87	19th	12	1·520	...	..	10
September ...	10·53	1·94	24th	27	9·57	1·56	25th	22	8·480	...	..	26
October ...	7·22	1·42	6th	21	6·23	1·42	7th	14	5·152	...	...	18
November ...	1·67	0·56	14th	10	1·61	0·90	15th	5	1·055	...	...	6
December ...	10·40	1·12	26th	25	11·65	1·28	28th	19	4·790	...	...	21
Total ...	50·04	8·96		203	47·35	9·03		143	31·018			159

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	T. Hutchins (Gardener), Gwernyfed Park, Breconshire.				F. J. Mitchell, Llanfrechfa Grange, Monmouthshire.				E. Tudor Owen, Ash Hall, near Cowbridge, Glamorgan.			
Rain Gauge { Diameter of Funnel.....	5 inches.				5 inches.				8 inches.			
Rain Gauge { Height { Above Ground ...	1 foot.				4 feet.				1 foot.			
Rain Gauge { on Top { Above Sea Level (As levelled from Ordnance B.M).	350 feet.				322 feet.				315 feet.			
1896.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which .01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	0·94	0·28	24th	16	1·03	0·435	24th	9	1·63	0·55	24th	11
February	0·63	0·18	8th	12	0·65	0·022	19th	6	1·80	0·53	8th	13
March	3·13	0·41	7th	29	4·33	0·059	2nd	24	6·29	1·13	7th	28
April	0·73	0·15	10th	17	0·89	0·020	10th	13	1·21	0·25	13th	15
May	0·27	0·12	13th	4	0·49	0·035	13th	2	0·06	0·05	21st	2
June	1·54	0·55	9th	15	2·51	0·090	7th	11	2·22	0·55	15th	12
July	1·18	0·27	24th	13	1·66	1·004	24th	8	2·38	0·80	24th	12
August	2·37	0·58	31st	17	1·81	0·050	1st	12	2·85	0·69	19th	15
September	5·84	1·05	8th	29	8·16	1·016	17th	25	9·08	1·50	21st	26
October...	3·40	0·41	7th	20	5·23	1·017	6th	20	3·86	0·99	5th	16
November	0·95	0·38	14th	10	1·03	0·064	14th	6	0·92	0·32	7th	8
December	5·89	1·51	4th	27	6·84	1·008	27th	24	8·38	1·03	4th	24
Total	27·87			209	34.63			160	40·68			182

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	Miss H. A. Lewis, Tan-yr-allt, Ystalyfera, Glamorgan.				W. Jones, The Reservoir, Pontypridd, Glamorgan.				Henry Clay, Piercefield Park, Chepstow, Monmouthshire.			
Rain Gauge { Diameter of Funnel.. ..... Height { Above Ground.. on Top { Above Sea Level (As levelled from Ordnance B.M.)	8 inches. 1 foot 6 inches. 300 feet.				5 inches. 1 foot. 300 feet.				5 inches. 1 foot 6 inches. 300 feet.			
1896.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	2·85	1·03	25th	13	2·61	1·10	24th	10	0·96	0·49	17th	8
February	1·64	0·99	9th	11	1·43	0·65	8th	7	0·48	0·17	8th	5
March	8·03	1·07	8th	27	6·59	0·92	19th	23	3·98	0·53	2nd	22
April	1·62	0·41	14th	16	0·83	0·25	16th	7	0·54	0·20	13th	10
May	0·07	0·07	22nd	1	...	...	...	...	0·17	0·10	22nd	3
June	2·38	0·45	17th	14	2·82	0·85	18th	13	2·24	0·56	4th	14
July	3·79	0·87	25th	13	1·20	0·32	8 & 24	7	1·07	0·30	24th	10
August	3·65	0·81	19th	19	2·79	0·86	18th	8	1·73	0·58	30th	10
September	11·86	2·57	18th	26	11·87	2·25	17th	24	7·45	0·80	24th	25
October	7·35	1·30	7th	17	8·34	1·75	6th	19	4·35	0·73	25th	21
November	2·45	0·92	5th	9	1·48	0·40	14th	9	0·94	0·63	14th	5
December	11·96	1·36	28th	25	10·24	1·00	26 & 27	20	4·27	0·49	12th	22
Total	57·65			191	50·20			147	28·18			155

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map	Sir H. M. Jackson, Bart., Llantilio Court, Abergavenny, Monmouthshire.				Edwin C. Pole, Neath, Glamorgan.				Thos. Coomber, pro Lord Llangattock, The Hendre, Monmouthshire.			
Rain Gauge { Diameter of Funnel.....	5 inches.				5 inches.				8 inches.			
Rain Gauge { Height above Ground..	10 inches.				1 foot.				1 foot.			
Rain Gauge { on Top above Sea Level	207 feet.				204 feet.				176 feet.			
(As levelled from Ordnance B.M.)												
1896.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	0·64	0·12	24th	6	1·97	0·50	24th	13	0·48	0·11	24th	10
February	0·49	0.22	19th	3	1·40	0·61	8th	10	0·33	0·11	8th	8
March	2·92	0·50	20th	16	5·12	0·94	7th	28	2·60	0·41	20th	27
April	0·44	0·13	12th	5	1·15	0·33	13th	15	0·54	0·13	13th	15
May	0·71	0·27	13th	4	0·07	0·07	21st	1	0·46	0·30	13th	3
June	2·95	1·28	9th	8	2·07	0·44	17th	12	2·90	1·43	9th	13
July	1·64	0·56	25th	8	3·37	0·74	25th	13	1·90	0·88	23rd	7
August	2·08	0·60	1st	11	3·04	0·94	19th	16	1·12	0·22	26th	13
September	5·11	0·83	24th	19	7·55	1·34	17th	26	5·99	1·62	4th	25
October	2·98	0·97	6th	13	5·20	0·97	6th	17	3·37	0·72	6th	17
November	0·93	0·53	14th	4	1·59	0·44	14th	9	0·72	0·43	14th	9
December	5·28	0·73	4th	19	9·81	0·97	12th	27	4·22	0·71	4th	24
Total	26·17			115	42·34			187	24·63			171

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map..... / Rain Gauge { Diameter of Funnel..... Height on Top { Above Ground... Above Sea Level (As levelled from Ordnance B. M.)	Godfrey L. Clark, Talygarn, Llantrisant, Glamorgan. 5 inches. 1 foot 8 inches. 150 feet.				C. H. Priestley, Lisvane Reservoir, Glamorgan. 5 inches. 1 foot. 150 feet.				O. H. Jones, Fonmon Castle, Glamorgan. 8 inches. 1 foot 2 inches. 130 feet.			
1896.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	1·89	0·74	25th	13	1·18	0·43	24th	9	1·53	0·60	24 & 25	9
February	1·22	0·56	9th	10	0·66	0·23	8th	14	1·13	0·30	20 & 21	9
March	8·19	1·67	8th	25	3·75	0·41	20th	25	6·56	0·82	7 & 8	25
April	0·83	0·07	11th	14	0·81	0·15	30th	14	1·14	0·26	13 & 14	10
May	0·25	0·08	24th	3	0·27	0·23	13th	2	0·17	0·08	1st	3
June	2·34	0·50	17th	12	2·70	0·73	7th	14	2·54	0·60	7 & 8	11
July	2·00	0·78	25th	11	1·14	0·31	24th	11	1·50	0·41	8 & 9	10
August	3·24	0·97	30th	16	1·97	0·53	19th	16	3·26	1·15	19 & 20	12
September	12·14	2·56	25th	26	7·72	1·12	21st	25	8·31	1·21	17 & 18	23
October	5·40	1·03	7th	17	4·02	0·66	6th	20	4·94	0·82	24 & 25	21
November	1·57	0·71	15th	9	1·03	0·60	14th	8	1·22	0·20	14, 15, 18, 19	9
December	11·18	1·38	26th	21	6·13	0·76	4th	23	7·87	1·04	4 & 5	21
Total	50·25			177	31·38			181	40·17			163

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	C. H. Priestley, Cogan Pumping Station, Glamorgan.				Iltyd Nicholl, The Ham, Cowbridge, Glamorgan.				Franklen G. Evans, F.R.A.S., F.R. Met. Soc., &c. Llwynarthan, Castleton, Monmouthshire.			
Rain Gauge { Diameter of Funnel.....	5 inches.				9 inches.				5 inches.			
Rain Gauge { Height { Above Ground...	1 foot.				1 foot 3 inches.				1 foot 1 inch.			
Rain Gauge { on Top { Above Sea Level	121 feet.				96 feet.				72 feet.			
(As levelled from Ordnance B.M.)												
1896.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	0·99	0·40	24th	10	1·09	0·39	24th	11	1·00	0·44	24th	9
February	0·92	0·45	29th	11	1·20	0·37	8th	10	0·63	0·23	8th	12
March	4·52	0·44	2 & 7	26	4·22	0·91	6th	22	4·11	0·44	2nd	25
April	0·80	0·14	12 & 30	12	0·97	0·36	13th	9	0·97	0·12	11, 13, 16	17
May	0·25	0·17	13th	3	0·08	0·08	21st	1	0·23	0·13	13th	4
June	2·11	0·33	4th	13	2·53	0·47	4th	12	2·68	0·64	7th	14
July	1·48	0·30	8th	9	1·18	0·36	24th	8	1·39	0·40	24th	11
August	2·49	0·83	19th	16	1·55	0·46	19th	14	2·51	0·75	8th	13
September	9·08	1·57	17th	27	7·14	1·09	21st	23	7·74	1·33	17th	25
October	4·24	0·97	24th	22	4·54	1·03	24th	17	4·15	0·82	24th	21
November	1·00	0·53	14th	13	0·93	0·23	14th	8	1·20	0·76	14th	9
December	6·23	0·70	27th	23	4·67	0·59	1st	23	9·16	0·95	2 & 18	24
Total	34·11			185	30·10			158	35·77	7·01		184

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD—Continued.

No. of Gauge on Map.....	G. Evans, The Rest, Porthcawl, Glamorgan. 5 inches. 1 foot. 60 feet.				C. H. Priestley, Ely Pumping Station, Glamorgan. 5 inches. 1 foot. 53 feet.				A. A. Pettigrew (for A. Pettigrew), Castle Gardens, Cardiff, Glamorgan. 5 inches. 1 foot. 38·36 feet.			
Rain Gauge } Diameter of Funnel..... Height } Above Ground.... on Top } Above Sea Level (As levelled from Ordnance B.M.)												
1896	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.	Total Depth	Greatest Fall in 24 hours.		No. of Days on which ·01 or more fell.
	Inches	Depth.	Date.		Inches	Depth.	Date.		Inches	Depth.	Date.	
January	0·87	0·29	23rd	9	1·25	0·56	24th	11	0·97	0·37	24th	9
February	1·32	0·52	8th	8	1·05	0·27	8th	16	0.84	0·22	29th	11
March	3·63	0·50	6th	21	5·25	0·65	7th	28	4·55	0·49	7th	26
April	0·56	0·24	13th	6	1·01	0·18	30th	14	0·91	0·16	30th	12
May	0·08	0·08	21st	1	0·14	0·08	13th	3	0·18	0·08	13th	3
June	1·40	0·48	4th	9	2·64	0·67	7th	11	2·92	0·50	25th	12
July	1·85	0·53	8th	10	1·64	0·45	24th	11	1·40	0·36	24th	11
August	1·69	0·40	24th	12	3·00	0·87	19th	15	3·46	1·23	8th	14
September	6·19	1·04	21st	21	9·67	1·53	21st	25	8·63	1·27	21st	23
October..	3·78	0·76	28th	14	4·77	0·83	24th	19	4·53	0·90	24th	20
November	0·73	0·23	14th	7	1·18	0·72	14th	11	1·13	0·71	14th	8
December	5·02	0·60	27th	21	7·59	0·87	27th	23	6·82	0·81	27th	23
Total	27·12			139	39·19			187	36·34			172

German Popular Songs.

By W. RÖNNFELDT.

Read before the Society, March 25th, 1897.

THE subject on which I am going to address you to-night is a very humble one. It does not deal with those mighty creations which have become the admiration of the world, nor shall I have occasion to refer, except indirectly, to men like Beethoven and Wagner. And yet I am inclined to think that popular songs have done more, not only to foster a love of music, but to lighten man's weary toil, to relieve the monotony of his existence, to cheer his merry-making, and to console him in his afflictions, than all the greatest compositions of all the greatest masters taken together. This must be my justification and apology for choosing the subject.

It might appear a work of supererogation to define what I mean by popular songs; yet a word of explanation may be necessary for those members of my audience who have not resided in Germany. I do not mean songs which enjoy a transient popularity, or which were popular once upon a time, nor songs which deserve to be popular, but songs which are permanently popular, which have gone to the heart of the people and become the property of a whole nation, which are known to, and sung by, everybody and everywhere throughout the country. They are called in German "Volkslieder," for which the English language has no exact equivalent, just as the thing itself can hardly be said to exist in this country. There are, of course, plenty of English popular songs in the ordinary acceptation of the term, but they are not universally known and sung. As regards Scotland and Ireland I am not competent to judge, not having resided in those countries. I am, of course, aware that every Scotchman can join in "Auld Lang Syne," and I have no doubt that every Irishman can sing the "Last Rose of

Summer"; but how many of their other songs they know by heart I am not able to say. Wales I must exclude altogether from my consideration, as I am ignorant of the language, and therefore do not even know which are secular and which are sacred songs.

One of the first observations which a foreigner who has come over to this country will make is that the English, apparently, never dance and never sing. You will of course understand without any explanation on my part that I do not refer to that small section of the community that attend balls at the Park Hall, or that are members of musical societies or church or chapel choirs. I mean the mass of the people, the bulk of the nation, the tinker and tailor, the soldier and sailor, the servant girl and factory hand, the collier and farm labourer. Do they ever dance, and, if so, when and where? In Germany it would be difficult to find a town, however small, without one or more establishments where dancing goes on every Sunday. You must not be shocked at their taking their amusements on Sundays; it is the custom all over the continent. When I was last summer in the Bavarian Highlands, I took a walk one Sunday afternoon to the top of a hill, from which Baedeker recommends the view as very fine. On approaching the restaurant, which you find on almost every picturesque hill in Germany, I heard strains of music, and on entering the hall I found a fiddler and a zither player making music and a number of couples dancing. Now that was quite an impromptu hop. The young people from the neighbouring towns, villages and farms, go there for the purpose of having a walk and enjoying the fresh air; the men drink a glass of beer, the girls take a cup of coffee, and when a sufficient number are gathered together, they set to and have a dance, and the musicians turn up regularly on the chance of earning a few pence. That sort of extempore dancing is, according to my experience, very rare in England, and the same may be said of impromptu singing. I have heard part singing in a railway train, and once, on a Sunday evening, on the downs at Porthcawl; but, in both cases, the songs appeared to be not English but Welsh, and, in the latter case, were undoubtedly hymns, which, of course, I do not include among popular songs. In Germany, on the other hand, when students are congregated at a convivial gathering, or soldiers resting after drill, or young people out for a picnic, they will probably burst into song, and if you were to take at random a number of students from a university, sailors from a ship, soldiers from the barracks, factory hands from the mill or labourers from the plough, most of them would be able to join in all the songs I am going to give you as illustrations to-night. I can even give you a proof of this nearer home. We have a German Sailors' Home in Bute Road. At Christmas all the sailors at Cardiff, Penarth and Barry are invited, a Christmas tree is dressed up, each of them receives a useful present to remind him of his Christmas at home, and then popular songs are sung, in which all of them, to the number of 60, 80, or even 100 men, join. I think you will agree with me that nothing analogous to this is to be found in England.

I do not know whether it will surprise some of you to hear that England once ranked very high in musical culture, higher than many other European countries. That was about the time of good Queen Bess, when England was called Merry England, when people were still in the habit of singing on the village green and dancing round the Maypole. There can be no doubt about the fact; for it is not only recorded by historians, but we have independent proof of it in the excellent madrigals and glees which have come down to us, and it is also confirmed by the literature of that period. In Shakespeare's "Twelfth Night," for instance, Sir Toby Belch, Sir Andrew Aguecheek, and the clown sing what was then termed a catch, and what would now be called a canon. I think we are justified in assuming that madrigals and glees, which require some musical training, would not have been written in such numbers, unless there had been plenty of people able to sing them, and that Shakespeare would not have given a canon to a rake, a fool, and a clown, if the practice of this class of music had not been common in his day. I need hardly say that popular songs must have been exceedingly plentiful at that time and much more numerous than those that have been preserved; for popular songs are the basis and foundation of all poetry and all music, and must always precede in time and, at least, in the early stages of a nation's musical development exceed in numbers any other forms of music whatever. About the same time, *i.e.*, in the sixteenth century, Germany also was very rich in popular songs. Then a sudden re-action set in, which, though not due to the same cause in each country, had the effect of putting a stop to popular singing in both countries. The cause in England was the wave of Puritanism which passed over the country, banishing all mirth and merriment, and of which the nation feels the effect to this day. The cause in Germany was the thirty years' war. The words "thirty years' war" are easily pronounced; it is not so easy to realise what they imply, and to fully comprehend what a terrible scourge that war was to the poor country. Just imagine a war that lasted for a whole generation, and was conducted not by disciplined armies, but by soldiers of fortune; men who sold themselves to the highest bidder, who did not even receive regular pay, but looked to booty and plunder as their main reward; men who had not a spark of patriotism, humanity, or mercy, and to whom the most diabolical crimes were a source of amusement and a pastime. The lips refuse to utter, the hand shrinks from writing down the fiendish atrocities which were committed by those ruffians in the sacred name of religion. At the conclusion of the war Germany was almost depopulated, a wreck, a wilderness overgrown with bushes and weeds, with towns, villages, and farmsteads reduced to ashes, with fields and vineyards destroyed. There were villages without a single inhabitant left in them; there were other villages in which more wolves than human beings were to be found. It is no wonder then that the spirit of the people was broken, that there was no voice left to keep the old songs alive. There was plenty of call for sighing and weeping, but not for singing. Nor was Germany even then

by any means at the end of her miseries. Within forty years after the conclusion of the thirty years' war, she had already been twice invaded by French armies, which committed such inhuman cruelties and atrocities that a French writer of our own day, M. Edmond About, says that the mere thought of those two expeditions was enough to make his flesh creep and his hair stand on end. Then came the eighteenth century with nothing but fresh wars, from the war of the succession in Spain, which was fought out principally on German territory, in the beginning, to the seven years' war about the middle, and the Napoleonic campaigns at the end of the century. Meanwhile, when the august German sovereigns, by the grace of God, did not happen to have a war of their own on hand, many of them did not scruple to sell their subjects like chattel to foreign nations at so much a head, to serve as food for powder, while they pocketed the money themselves and squandered it on mistresses and palaces. The English Government bought a good number of those poor white slaves from the Fatherland during the American War of Independence and shipped them off to Canada. At last the dawn began to break which was to revive popular songs in Germany. It was ushered in by the intellectual renaissance of Germany, represented by Lessing and Kant, by Schiller and Goethe. Among the many eminent literary men of that period it was especially Goethe's friend, Gottfried Herder, to whom Germany is indebted for the revival of popular songs. Herder has little claim to be considered a poet, but he recognised the value of those old songs, rescued from oblivion as many of them as he could find, translated a large number from other languages, and appealed to all literary men in Germany to make a diligent search for any old songs which could still be recovered. This was done, principally, by Arnim and Brentano, who published a valuable collection of them. I will only add in passing that it is not of these that I am going to treat to-night; not songs which exist in books, but songs which are sung to-day, are the subject of my address. A still more important factor in the revival of popular songs in Germany was the war of liberation begun in 1813, which culminated in the battles of Leipzig and Waterloo, the rising *en masse* of the nation for the purpose of shaking off the yoke of Napoleonic oppression under which they had languished for so many years. The first patriotic songs composed and published on that occasion awakened an echo through the whole length and breadth of the country and created an extraordinary enthusiasm. It soon became clear that songs were as necessary as the daily bread to the nation, which by that time was possessed of a high degree of musical culture; a diligent search was made for the old tunes, many new songs were added, and the ball which was thus set in motion has been kept rolling to the present day. Nor was it long before the Germans, not satisfied with their own wealth of songs, turned their attention to other countries and adopted, translated, and naturalized whatever was suitable to their purpose. The result is that many foreign songs are, perhaps, better known and more frequently

sung in Germany than in the country of their birth. There is, for instance, a Scotch song, "Long, long ago," which I have never heard during my long residence in England, but which is very well known and frequently sung in Germany. Of the illustrations I have chosen, the first is a Russian, the second a Swedish song, while the remainder are German. I must, however, add that Germany, in this connection, is not to be understood as referring only to the country bounded by the political frontiers of the present empire, but as including parts of Austria and Switzerland, which belong to Germany, ethnologically speaking.

From the foregoing remarks you will have concluded, and correctly so, that most of the German popular songs are the product of this century. In fact, two of the best known of all, which every German child and adult sings, were born, so to speak, under my own eyes. The words were written by the poet Geibel, who was a native of the same town as myself, and who temporarily taught literature at the college I attended, and the tunes of the two songs were composed, one by our Professor of Greek, the other by our Professor of Physics. Of the old songs, many received a new musical setting, the original melodies having been lost. Among those which have been preserved complete, two deserve a special notice, as they are as familiarly known to this day as "Home, sweet home" in England, a student's song in Latin, "Gaudeamos igitur," of which both words and melody date from the beginning of the sixteenth century, and a song "Prinz Eugen," describing the siege of Belgrade in 1717, and written and composed by a soldier who took part in that siege. The latter song has an additional interest, inasmuch as it is written in the very unusual metre of five, instead of four crotchets to the bar.

I have, so far, been compelled to use the expression popular songs for want of a more exact term, but not all popular songs are "Volkslieder." Schubert's, for instance, are not, although they are popular, not only in Germany but everywhere else as well. There is, in fact, a distinct difference in the form and character of the two classes of songs, which is based upon the circumstance that "Volkslieder" are intended to be sung in the open air, without accompaniment, and in parts or by a chorus. Their principal element consequently is a simplicity which songs like those of Schubert, Schumann, Franz, etc., do not possess, a simplicity in melody, harmony, and words. Taking this last subject first, it appears to me that English poetry, at least English modern poetry, is very deficient in verses suitable for popular songs. This is, of course, no reflection upon the poets, who cannot be blamed for expressing themselves in their own lofty manner, instead of writing simpler verses, merely for the purpose of enabling somebody else to set them to music, and if there were any demand for that description of poetry, a supply would soon come forth. I should like, however, to take this opportunity of saying that, in my opinion, the English poets of the Victorian era, labour under two disadvantages, one referring to the subjects chosen, the other

to the mode of expression, which make their productions unsuited for popular songs. The first of these is the philosophical, introspective, analytical and reflective character of much of the poetry written at the present day. This character is due to the critical and cultured spirit of the age, and, though it inevitably produces a certain lack of freshness and of spontaneity, the poets themselves cannot perhaps be blamed for it, as it is not given to many men to withdraw themselves from the spirit of their time. There is, however, another disadvantage with regard to which they are not altogether free from blame, viz., the stilted and artificial language they use. Many of them, though of course not all, appear unable to call a spade a spade, and seem to think that recondite, abstruse and uncommon modes of expression form the essence of poetry. When, for example, William Watson speaks of the "facile largess of a stintless muse." I must admit that every one of these words can be found in an English dictionary, and may therefore be considered to be English; there is however a want of strength, a flabbiness in this mode of diction which, in my opinion, detracts very much from its beauty.

This was not the case with Wordsworth or Byron, nor with the poets of the eighteenth century, nor with Milton, not even with Shakespeare. The last-named poet is certainly at times somewhat obscure; but it has to be considered that he had more to say than any other writer before or since, that he had a richer vocabulary at his command than anybody else, and that in the three hundred years since his time many words have become obsolete which were perfectly familiar to his contemporaries. I, individually, at least, have found some poets of our era not only less fresh, but also less lucid, and considerably more difficult to understand than Shakespeare. The fault to which I refer is the same that was made by the French classic poets, who wrote in a lingo which was very different from ordinary French, and which makes their writings appear stilted and artificial. Now, I do not want to sing the praises of German literature; it is admitted by the Germans themselves that, in point of style, their prose ranks far below English, and still further below French prose. The Germans, however, have one advantage, viz., that their poetry and prose are the same language, and the consequence of this has been that the smaller poems of men like Goethe, Heine, Uhland and others, though not written for the purpose, have been found perfectly suited for popular songs. The greatest writer of such verses in this country is, in my opinion, Robert Burns; his "John Anderson my Jo," for example, combines the utmost simplicity and directness of expression with beauty of thought.

Of the German writers of popular songs, I will only mention Theodor Körner, whose father was an intimate friend of the poet Schiller. On the outbreak of the war of liberation in 1813, young Körner entered the army as a volunteer, and died soon after on the field of battle, in the twenty-second year of his age. As a poet in other branches of the art, he does not rank very high; but his patriotic and war songs, conceived during the day in the saddle and in the evening by the

camp fire, written, moreover, in the most simple language, breathe a spirit of reality and actuality which produced an extraordinary enthusiasm through the whole nation, and appealed to the hearts of the people, as poems of more pretentious composition could never have done. Many of them like "Lützow's wilde Jagd" will not soon be forgotten.

As popular songs are intended to be sung in the open air and without accompaniment, it follows that their musical setting must be extremely simple, so as not to require a heavy tax on the memory, while a thoroughly accentuated rhythm is, of course, equally indispensable. The melody must be conspicuous, the verses are generally short, consisting of eight, twelve or sixteen bars, and all the verses are sung to the same tune. For this reason, if for no other, a song like Braham's "Death of Nelson," however popular, would not be a "Volkslied." The harmony, also, must be extremely simple and easily identified so as to admit of part or chorus singing. I may as well confess here that I have experienced some difficulty in the selection of my illustrations owing to the circumstance that German popular songs are certainly not intended for performance in a drawing-room or concert hall as solos with pianoforte accompaniment. Without this explanation on my part, some of you might be inclined to conclude from my illustrations to-night that all, or most German popular songs, were sentimental love ditties, whereas, in fact, the latter form only a small proportion. I have, however, been unable to include any examples of hunting, students', tourists', patriotic, convivial, martial, or comic songs, as they would not sound well without a chorus, whilst drinking songs require twenty young fellows seated round a table, each with a mug of Bavarian beer in front of him. I have, occasionally, heard the "Millwheel," which I give you as an illustration to-night, and other German popular songs performed at concerts in this country in an artistically embellished form; this is never done in Germany, where "Volkslieder" invariably retain their original simple garb.

The writing of the tunes, as also of the words, of popular songs does not require talent of a very high order, but it is nevertheless a gift which not everybody possesses. Browning and Wagner would probably have been as unable to write, one the words, the other the music of popular songs, as Shakespeare might have found a difficulty in writing poetry for the purpose of advertising Beecham's pills. Of the German composers of this class of music many are only known by name, while of some others not even the name has been preserved. There is, however, one, Friedrich Silcher, who deserves a passing notice. He was conductor at Tübingen in Würtemberg, where he died in 1860. I do not know whether he has written any other musical works; if he has, they have fallen into oblivion. For the composition of popular songs, however, he seems to have possessed an extraordinary talent, and for many of the very best of them we are indebted to his pen.

I should like now, with your permission, to refer to a question which has often been discussed in magazines and reviews, and to which I have

never yet seen an answer given which fully represents my own opinion, viz., the question: Are the English people a musical nation or not? I do not think we shall find it difficult to discover a correct answer, if we examine for a moment the causes of Germany's present pre-eminence in music, and bear in mind that she has only been thus distinguished for the last 150 years, a very short span in the history of a nation, while previously to that time England occupied a high position and before her, first, the Netherlands, and then Italy, where music was introduced and cultivated by immigrated Flemings. The difference between the musical culture of England and Germany at the present day is easily explained by the social and political condition of the two nations during the last two centuries. *Non omnia possumus omnes.* The English have always excelled in all kinds of sport: fishing, rowing, yachting, riding, hunting, racing, shooting, cricket, football, tennis, golf, it would have been a wonder if they could have found time to cultivate music also. Moreover, they have enjoyed constitutional liberty for centuries; they have always taken an active part in all political events, and found enough to do in their spare time without strumming on the piano. The Germans, besides being accustomed to a much more contemplative, sedentary mode of living, were in an altogether different political position. The Emperor, who was the nominal head of the state, had as such no power whatever, and was a mere lay figure. The empire was, up to the year 1815, really governed by no less than 300 independent, and about 1,500 semi-independent temporal and spiritual rulers, all of them autocrats and many unmitigated scamps, who oppressed their poor subjects so cruelly and wantonly that the latter fell back upon music as about the only leisure occupation with which the police did not interfere. Similarly, the Poles, the Hungarians, the Bohemians, who were equally oppressed, also distinguished themselves in music. It sounds almost like a joke that as recently as the latter part of the last century strict police regulations were in force in many parts of Germany, by which the poor subjects were bound to observe certain sumptuary laws, and prohibited from going out of town more than a certain number of times per week, from spending too much time in gossiping, from smoking in the street, etc. Fortunately, however, even those high and mighty potentates, by the grace of God, did some good, though without intending it; as Shakespeare says: "For nought so vile that on the earth doth live, but to the earth some special good doth give." Dressed in their little brief authority, they took it into their august heads to copy the example of the French court, which at that time gave the tone in everything. They sent their sons to Paris, to forget their native language as much as possible, and to aquire French polite manners and vices. In imitation of Versailles they built, of course at the expense of their subjects, sumptuous palaces and laid out those magnificent parks, which to this day compel the admiration of visitors to the former residential capitals of these princes, and lastly, also in imitation of the French court, they kept orchestras and theatres of their own, for which they engaged Italian singers and dancers regardless of

expense. I will only remind you that Beethoven's father was court singer to his Eminence the Prince Elector and Archbishop of Cologne, and that Mozart, father and son, were attached to the orchestra of the Archbishop of Salzburg, while Hadyn was bandmaster of Prince Nicholas Esterhazy. The musical training of the three greatest composers of their time is thus already accounted for, and I need hardly point out that, if the predecessors of Lord Bute and the Bishops of Llandaff had kept orchestras and theatres, with operatic artists for the last 150 years, Cardiff would now occupy a higher position musically than it does; while on the other hand, if Beethoven and Wagner had been born and bred and spent their lives at Cardiff in the latter part of the last and the first half of the present century, their musical genius would probably have remained dormant, and never have been developed at all.

The number of independent German Sovereigns has now, I am glad to say, been reduced to twenty-two, who still vie with each other—from more praiseworthy and honourable motives than their ancestors—in supporting and promoting the study of all arts and sciences. The intellectual activity which prevails at those small German courts is indeed surprising, and can be gauged by the fact that in many a German town a larger number of Shakespeare's plays is put upon the stage than in London itself. Some more data on this subject may perhaps be interesting to you. Passing over the larger capitals Berlin, Munich and Dresden, and confining myself to the smaller towns, I have first to mention Karlsruhe, the capital of the Grand Duchy of Baden, where the renowned Mottl, as conductor of the court orchestra, brought out the whole of the works of Berlioz, France's greatest composer, before some of them had even been heard in Paris. Karlsruhe, however, with its 70,000 inhabitants is a large town in comparison with others I have to refer to. Weimar, a hundred years ago, when it contained only 6,000 inhabitants, was ruled by an enlightened duke, Karl August, who attached to his court the four most eminent literary men of his time, Goethe, Schiller, Herder, and Wieland; while Fichte, the greatest philosopher of the day, taught at the neighbouring University of Jena, which also belonged to the duke. His successor, the present ruler, who has the title of grand duke, has distinguished himself in the support and patronage of music. Joachim, the greatest classical violin player of our time, was leader, Liszt was for many years, and Stavenhagen, the eminent pianist, now is conductor of his orchestra. At Weimar, which at present contains about 25,000 inhabitants, the first performance of Wagner's Tannhauser on any stage took place in 1845, that of the same composer's Lohengrin in 1850. Neither of these opers was heard in London till about 20 or 25 years later, while Cardiff with its 170,000 inhabitants has only quite recently—that is, 52 years later than Weimar—had an opportunity of hearing Tannhäuser, the prospect of a performance here of Lohengrin being still in the dim and distant future. Nor are the exertions at Weimar by any means confined to German compositions. "Samson and Delilah," the principal work of Camille

Saint-Saëns, who is perhaps the greatest French composer living, was brought out at Weimar in 1877, while at Paris, where the composer himself resides, it did not obtain a hearing till 1890. Coming to still smaller towns, I have to mention Meiningen, with its 12,000 inhabitants. This little town twenty years ago, and before Sir Henry Irving's time, was able to boast of having one of the best dramatic companies in Europe, which gave a number of excellent and generally admired performances in Drury Lane, as well as one of the most perfect orchestras, conducted first by Von Bülow, and subsequently by the great conductor, Richard Strauss (now of Munich), and is at the present moment the residence of one of the most renowned clarinet players in the world, Mühlfeld, who has already twice been engaged by Messrs. Chappell to come over to London for the express purpose of taking part in the performance of Brahms's two clarinet quintets, at the Monday popular concerts in St. James' Hall. But even Meiningen is a large town in comparison with two others I have yet to mention: Detmold with 8,000 inhabitants, where Brahms, the greatest composer of the present day, was for several years conductor of the orchestra; and Sondershausen. This little place, situated on the slope of a picturesque wooded hill, the summit of which is crowned by the prince's castle and the opera house, and containing only about 6,000 inhabitants, seems to give itself up altogether to music. Its court orchestra, which gives no less than 26 classical concerts in the course of the winter, has had the distinction of being conducted by the eminent composer Max Bruch and led by Willy Burmester, one of the first violinists of the present day, while the present principal of the Royal Academy of Music in London, Sir Alexander Mackenzie, was one of the players.

The towns I have so far named are all residential capitals of independent sovereigns. The same energy and activity in the culture of music is however displayed also in every other town of Germany, principally in the shape of subventions and grants given by the municipality for the support of conservatoires, operas, and orchestras. Specially distinguished among them for excellence of their musical performances are Leipzig, Hamburg, and Frankfurt.

According to my opinion these facilities afforded for musical training, which cannot be matched in any other country in the world, are quite sufficient to explain the superiority of Germany, without attributing to that nation any exceptional natural aptitude or genius. On the contrary, I have little doubt that if the English should make up their minds to devote special attention to the study and practice of music, they would, with their great strength of will and unflagging activity and thoroughness, very soon occupy a prominent position among nations in this respect also; and in the meantime I should consider it a great advantage if the singing of popular songs could be promoted among children, either by means of the Board Schools or through some other agency. There would then be hope of that spontaneous singing which is so characteristic of Germany, and which, while exerting a cheering

effect on singers and listeners, at the same time educates the ear and thus imperceptibly provides a considerable musical training. As it is, the progress which has been made in England during the last thirty or forty years in the practice and appreciation of music is enormous, and the same may be said of Cardiff as in a large measure an English town. A person who had left Cardiff thirty years ago and were now on his return to attend, say, one of the Musical Society's concerts, conducted by Mr. Aylward, would no doubt be surprised at the change for the better which has taken place. As regards Wales proper, she appears to me to have stood still; she is behind most other European countries now in musical matters, and she will fall still further behind unless she provides means for the training of the musical talent which her sons and daughters undoubtedly possess, and unless she remodels and reorganises her eisteddfod in accordance with the spirit of the age and the requirements of the time.

There is another subject of a somewhat similar character, on which I should like, with your permission, to take this opportunity of expressing my opinion, viz., on the natural aptitude of the two nations for the acquirement of foreign languages. I have often heard it said that the Germans are naturally good linguists and that the English are not. I do not share that opinion in the least; on the contrary, I have often enough met Englishmen who were possessed of a very considerable and exact knowledge of more than one foreign language. The difference between the two countries in this respect appears to me to be of a two-fold nature. In the first place, the English do not feel the same necessity of devoting time and study to the subject, because their language is spoken and understood almost everywhere. For the same reason the French are poor linguists, whilst not only Germans, but all other nations whose tongue is not generally understood, the Dutch, Scandinavians, Russians, Poles, Bohemians, Swiss, etc., are obliged to learn English and French at school, whether they like it or not. The second difference consists in the manner in which foreign languages are taught. I knew a school, not a hundred miles from Cardiff, in which French was taught by a master who himself was ignorant of the pronunciation of any single word in that language. I also remember reading many years ago an article—by Sir Mountstuart Grant-Duff, if I mistake not—in a monthly magazine, in which the writer stated of the Eton Latin Grammar then in general use, that there might possibly be a worse book in the world, but that he considered it exceedingly improbable. He further related that a boy at Eton, on being scolded for knowing less Latin than his younger brother, retorted: "My brother has only been here for two months; in another six or twelve months he will know as little as I do." I have no doubt that the teaching in English schools has improved immensely in the last twenty years, and feel confident that English children will learn foreign languages as easily as other nations, if they and their teachers will clearly recognise:—

(1) That pronunciation, conversation, and grammar of living languages must be taught simultaneously.

(2) That a preliminary study of Latin is indispensable, in order to teach students, for example, the difference between an accusative and a dative which their own language does not clearly show.

(3) That there is no royal road to learning, and that a foreign language can only be mastered by hard work, and cannot be "picked up," as the favourite saying is.

Biological and Geological Section.

REPORT FOR SESSION 1896-97.

COMMITTEE:

The PRESIDENT and HON. SECRETARY of the C.N.S. (*ex-officio*).
T. H. THOMAS, R.C.A., *President.*
W. W. PETTIGREW, T. W. PROGER, J. STORRIE,
W. N. PARKER, PH.D., *Hon. Sec.*
J. J. NEALE, and A. H. TROW, B.Sc., *Hon. Secs. for Field Walks.*

THE section has now completed its 10th session. The number of members on the books is 45, and at the seven ordinary meetings held during the session there has been an average attendance of 14.

The following papers have been read in the course of the session :—

1896.

Oct. 5th.—C. T. VACHELL, M.D.—"On two additions to the local Flora."

" " J. J. NEALE.—"Remarks upon a specimen of the Spinous Shark (*Echinorhynus spinosus*)."*

" " W. H. HARRIS.—"Notes on the Teeth on the proboscis of various Diptera."*

Dec. 3rd.—GAVIN H. JACK, F.G.S.—"On the Geology of some Physical Features in the Society's Field."

" " W. N. PARKER, PH.D.—"Notes on two specimens of *Echinorynus spinosus* (7ft. 3in. and 6ft. in length respectively), and on certain parasites (*Distomæ*) present in their stomachs, as well as on an abnormal Ray." (All these specimens were received from Mr. Neale.)

" " W. N. PARKER.—"Remarks on the use of Formalin."

1897.

Jan. 4th.—R. DRANE, F.L.S.—"A Pilgrimage to Golgotha."

Feb. 18th.—EVAN W. SMALL, B.Sc., and F. T. HOWARD, B.A.—"Further Notes on the Geology of Skomer."*

" " A. B. BADGER, B.A.—Exhibition of Slides of Corals and Coral-reefs.

Mar. 18th.—F. T. HOWARD, B.A.—"Notes on the base of the Rhaetic Series at Lavernock Point."

" " G. A. BIRKENHEAD.—"On a specimen the of Mole-Cricket (*Gryllotalpa*), found by Mr. W. W. Pettigrew in the new Ely Park."*

April 22nd.—ARCHIBALD MITCHELL.—"On *Sirex juvencus*."*

" " C. T. VACHELL, M.D.—"Remarks on the Flora of Wales," given in the Appendix to the Report of the Royal Commission on Land in Wales and Monmouthshire."*

May 6th.—J. J. NEALE.—"Notes on a Visit to Skomer."

In addition to the specimens shown in connection with the above papers, other exhibits were made by Messrs. Birkenhead and Harris.

Special Hon. Secretaries for the arrangement of Field Walks have been appointed, and a rule has been passed with regard to Student Associates.

Resolutions were passed with regard to the departure of Mr. F. T. Howard from Cardiff, and the death of Mr. J. Pyke Thompson.

Attention was drawn by the Hon. Secretary to a circular received from the Director of the Marine Biological Association, Plymouth, asking for statistics as to the occurrence of certain marine animals off different parts of the coast.

A committee was appointed to report as to the means to be adopted for suppressing pole-traps, and also to consider the advisability of recommending the County Council to adopt the Act of 1896 for the preservation of Wild Birds.

The accounts show a balance in hand of £14 15s. 2d.

W. N. PARKER,

Hon. Sec.

UNIVERSITY COLLEGE,

CARDIFF, *June 18th, 1897.*

* The papers marked with an asterisk have already appeared in the Society's Transactions.

Monstrous Form of "Plantago Major."

By T. H. THOMAS.

Exhibited to the Biological Section, Nov. 7th, 1895, and Oct. 5th, 1896.

THE plant illustrated was found by Miss Mabel Howell upon Mr. James Howell's land at Green Farm, Saintwell.

Three plants were growing fairly close together, but no more have been found having this peculiarity. Two plants remain in the field for future observation. Upon the specimen exhibited there were six flower stalks, all showing the same form of phyllody, in which the axis of the flower spike is extremely shortened, the flowers disappear, while the bracts attain a large expansion, the mass forming a rosette. A similar form, in the closely related species *P. media*, is figured in Master's "Teratology," and is spoken of as the Rose Plantain, common in gardens. A figure of a monstrous growth of *P. major* on the succeeding page shows a spike less shortened, so that the bracts do not form a rosette, although, in that case also, there is complete suppression of the florets.

The plant was potted in ordinary garden mould, and grew with greater luxuriance in 1896. It formed twelve heads, in which the axis was depressed as in 1895, but showing varied forms, from the rosette to spikes of an inch in length. Upon some of the heads buds formed, throwing out stalks surmounted by tiny rosettes of ⅓in. diameter, of these proliferous heads there were five.

Mr. J. Storrie mentioned that he had collected similar heads, also proliferous, from plants of *Plantago maritima*, growing upon mountain summits in Scotland.

In 1897 the plant again exhibits the peculiarity in a similar striking way; having been placed in a shady portion of the garden, the bracts are larger and still more leaf-like in appearance, appearing three years in succession under dissimilar conditions of soil and position, the variation may be considered constant.

Monstrous form of Plantago major, found by
Miss Mabel Howell, Green Farm, Saintwell, Cardiff, Sept., 1895
(Size of original).

Proliferous form from
same plant, 1896.

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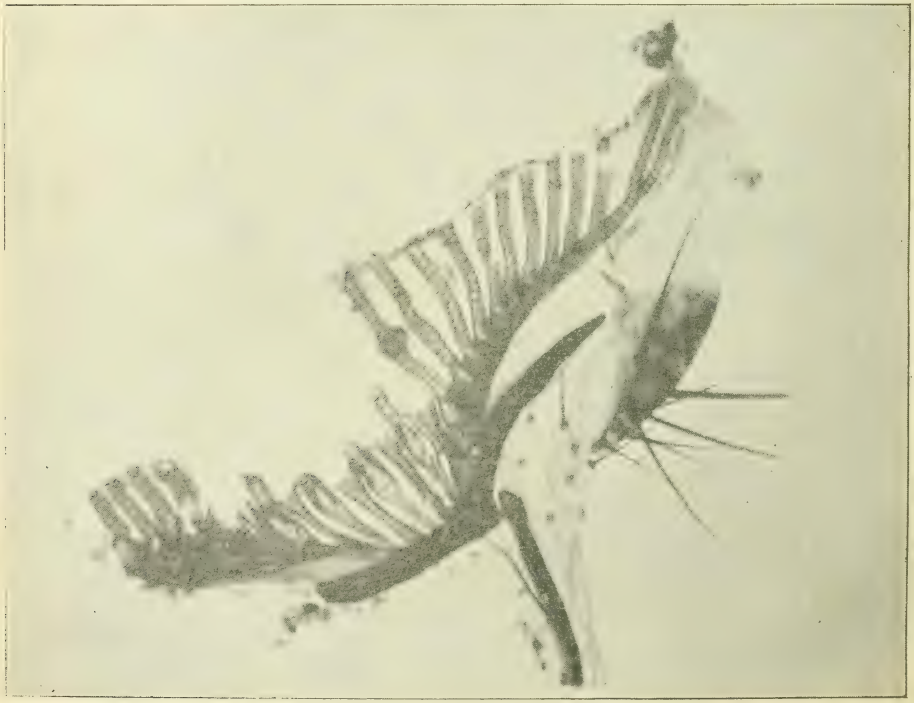

Note on the Teeth of Diptera.

By W. H. HARRIS.

Read before the Biological and Geological Section on October 5th, 1896.

IF you ask the question "Have you ever seen the teeth of a fly?" the probability is you will receive replies differing according to the knowledge of natural history possessed by the person addressed. Those without much entomological information will often say, "No; but they do bite." The entomologist will say, "No; I thought they lived by suction."

Each reply really conveys an inaccurate impression. Flies do not bite in the sense we understand the term; they pierce. Flies live by suction, but special organs are present in the proboscis of some species which function as teeth, to enable the insects to add a little finely divided solid material, as thickening, to the pabulum upon which they feed.

Again, in some species, the *Scatophaga* for example, the teeth are really formidable weapons of attack: these insects frequently capture small flies and feed upon them.

Scatophaga calida may be frequently seen on bushes in the Sophia Gardens, and it is exceedingly interesting to watch it stalking its prey; cautiously it moves, a few steps at a time, until it arrives within a short distance of the victim, when with a tiger-like spring the insect is seized and held by the proboscis between the front pair of legs, and the twelve powerful teeth speedily make an end of the little captive.

My attention was first directed to this subject, many years ago, by some correspondence in a scientific journal about the teeth of a blowfly. A slide had been put upon the market for sale by a most respectable firm, purporting to show these organs. One of these slides found its

way into the cabinet of a member of the Royal Microscopical Society, and a friend visiting him inspecting the slide, failed to detect the organs. He very foolishly wrote a letter to the journal, and made some rather strong remarks reflecting on the genuiness of the object. This elicited a courteous reply from the firm, assuring him that the organs were present, and intimating that it would have been much better to have written direct to them instead of rendering himself liable to an action at law.

Curiosity aroused, I determined to satisfy myself as to the presence of these organs, and after many failures, and to the great detriment of many blowflies, I obtained a very satisfactory display.

The thought then occurred, if blowflies possess these organs why not other species? I was soon at work, and the result has been that I have quite a large collection of these dental organs; exceedingly interesting and very instructive they proved to me. In one case, they were the means of adding a new species to the list. This fly was taken on Penarth beach, and my friend, Dr. R. H. Meade, of Bradford, an authority on Dipteria, described it in the Entomological Monthly Magazine, Vol. XXII., page 152, under the name "*Ceratinostoma maritimum*," thus identifying it by its mouth organs.

In another case, it was the means of bringing to his notice a fly he had described in his Monograph of the Diptera, on the authority of a previous author, but which he had never seen; both species appear to be widely distributed, but are rather scarce. These examples are very interesting as proving that these organs have some value in distinguishing species, which in itself is of some importance when dealing with a group of creatures whose external appearances are so much alike, and the features by which they are recognized are so minute.

It would require more space than is allotted to me to do more than just outline the subject, I have accordingly selected two examples as illustrations—one of the common dung fly, *Scatophaga stercoraria*, the other of the house fly, *Musca domestica*. In the former we have a typical display of the robust, in the latter of the delicate, in these organs.

Manifold variations occur, but there seems one common feature. The organs appear to be formed by modifications of the basal plates of the pseudo-tracheæ: these appear to become fused together to build up the teeth; when these are small the pseudo-tracheæ are well developed, but these latter organs are small or altogether absent when the teeth are large.

These organs appear to be used for puncturing, scraping, and probably crushing; their action is not the same as in vertebrates, the lobes of the labium open like the covers of a book; the teeth are situated at the base of the lobes, or, to continue the simile, near the back of the book, and follow their movements; they are actuated by muscular processes which cause the two halves to open and close, and the sides of the organs are then approximated, in which position they are well adapted for expressing the juices from the material upon which the flies feed.

MUSCA DOMESTICA.

Enlarged 165 diameters

SCATOPHAGA STERCORARIA.

Enlarged 165 diameters.

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The teeth are composed of chitin (C 9. H 15. N O 6.), in some cases they are almost transparent, and are then somewhat flexible; in others they are quite dark, and are then rigid, and break with a clean fracture like glass, when pressure is applied.

In the majority of the *Muscæ* and *Anthomyiidæ* the organs are strap-shaped, and simply bifurcated at their free ends; variations of specific value are obtained by the enlargement of one of the terminal points. They vary again in number when contained in a single row, or the rows may be duplicated; they are then superimposed, and each row slightly lengthened. I have seen as many as five rows thus arranged, the entire group of teeth numbering close upon fifty individual organs, while in another only six such teeth were present.

It must be noted that the illustrations depict the organs in *one* lobe of the labium (repetition being unnecessary). Both are shown on the same scale for comparison, and are enlarged one hundred and sixty-five diameters. Adjoining organs have been omitted to prevent confusion.

No. 1. This shows the teeth contained in one half the mouth of the common yellow dung fly, *Scatophaga stercoraria;* they are six in number. The two marginal teeth are small, and their form at the free end is typical of these organs in the blowfly; the four remaining teeth are very stoutly built, and are considerably thickened in the shaded parts, and deep amber in colour, except towards the base, where they are almost colourless. These exhibit some of the modifications which the free ends assume.

No. 2 illustrates the teeth of the house fly, *Musca domestica.* These are strap-shaped organs expanded at the free ends, which are very finely serrated. The margins of each tooth are recurved to give additional strength, as they are very slightly built and are almost without colour. There are five in each lobe.

Further Notes on the Geology of Skomer Island.

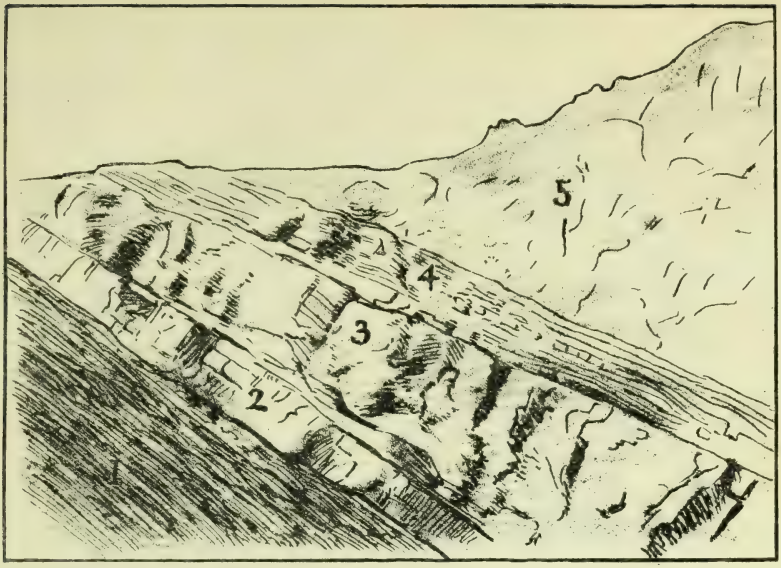
By F. T. HOWARD and E. W. SMALL.

Read in the Biological and Geological Section.

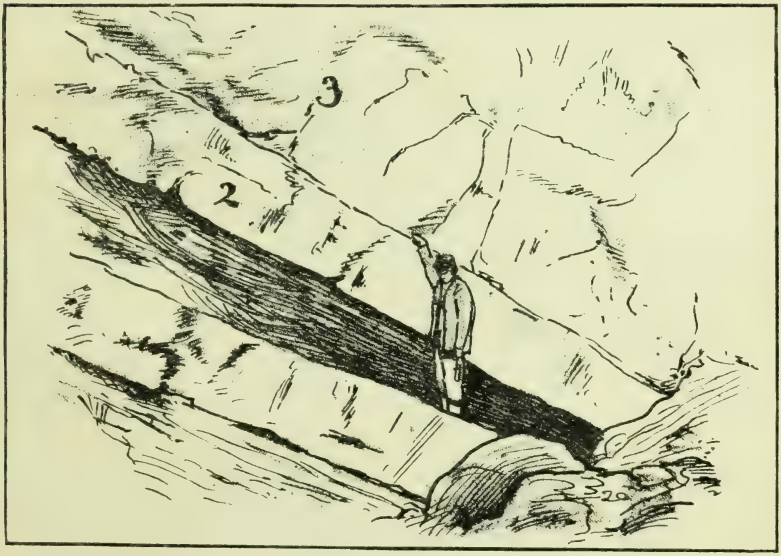
SINCE the reading of our short paper, entitled "Geological Notes on Skomer Island," on December 15th, 1896 (Transactions, Vol. XXVIII., part I.), we have had an opportunity of again visiting the island, and have photographed several of the more important sections described in our former paper as well as some others which we had not seen previously.

We were especially desirous of being able, if possible, to obtain decisive evidence as to whether the basaltic rocks, of which the island is so largely composed, are (as De la Beche held) of an intrusive character, or whether they were poured out as contemporaneous flows during the period (probably Bala) when the sedimentary grits and conglomerates were formed (as indicated in Murchison's Section). The junctions between the basalt and sedimentary beds, as seen near High Cliff and to the south of South Haven, appeared to be conformable ones, such as would be expected in a series of interbedded flows, but the curious series of ridges running across the island, and the association of felsites with basalts seemed to us to be more suggestive of intrusive sills. An examination of a very interesting section on the west of the island in Pigstone Bay, which we had not previously seen, appears to give satisfactory evidence of the contemporaneous character of both acidic and basic lavas, as will be seen by a reference to the figures. The upper part of the cliff forming the south side of Pigstone Bay, consists of a massive basalt; beneath this comes a band of what appears from a little distance to be a thinly-bedded sedimentary rock, but an examination of hand specimens and

I.



II.



EXPLANATION OF PLATE.

I.—View of part of Cliff on South Side of Pigstone Bay, Skomer Island.

5.—Basalt.
4. —Felsite.
3.—Basalt.
2.—Grits
1.—Shales and Conglomerate resting on an uneven floor of Basalt.

II.—Junction of Grits (2) and Basalt (3) in the same Cliff.

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of thin slices under the microscope shows it to be a felsite; beneath this felsite is another massive basalt resting conformably upon sedimentary beds consisting of hard quartz-grits and reddish shales, with a conglomerate (containing rolled basalt-fragments and spherulites of felsite) at the base. This conglomerate rests upon an uneven floor of basalt, from the disintegration of which it seems to be in part derived. Low down in the cliff, towards the north of the bay, another bed of grit appears to crop out below this basalt, but this part of the cliff is inaccessible from the land, and we had no opportunity of visiting it by boat. We hope, however, to be able to examine the whole section more completely on a future occasion, and to measure the thickness of the different beds. (The rough measurements of the upper part of the section which we made were unfortunately lost.) These bands of sedimentary strata appear to be striking across the island in an easterly direction, but there are no out-crops inland, and we did not succeed in finding them exposed in the cliffs on the north-east in the neighbourhood of North Castle. Probably, however, the blocks of quartz-grit found here on the surface, which we had previously supposed to be ice-borne boulders, belong to this series. Another exposure of quartz-grits, which we had not seen on our former visit, occurs at the extreme south of the island, and forms the narrow portion of land connecting (at low water) the Mewstone with the main island. It is evident that here, as in the case of the Wick, North Haven, South Haven, and Pigstone Bay, the geographical features have been determined by the more rapid erosion of the sedimentary beds.

We spent some time in again searching for fossils in the grits and shales, but without any success. We examined the so-called "Encrinite Grit," referred to by Murchison as occurring on the mainland at the south side of Wooslack Park, and collected a number of imperfectly preserved fossils (including a species of Tentaculites) which seem to indicate that the beds here are of Bala age. As the beds closely resemble those of Skomer, and have the same general dip, we are inclined to regard the sedimentary beds and associated igneous rocks of the island as belonging to this period.

The only other fresh observations which we have to record are:—(1) the occurrence to the west of the Wick, beneath the felsite conglomerate that forms the ridge running from the Wick to the north of Welsh Way, of a very coarse breccia resting upon and obviously derived from the banded and spherulitic felsite that is so well seen at Tom's House: (2) The occurrence of bands of ash in the basaltic cliffs, between the north point of the island and North Castle. Both these observations afford additional evidence of the contemporaneous character of both the basic and acidic lavas.

Notes on the Base of the Rhaetic Series at Lavernock Point.

By F. T. HOWARD.

Read at the Biological and Geological Section on March 18th, 1897.

DURING the summer of last year I visited with my students the cliff between Penarth and Lavernock, on a preliminary scamper before settling down to the more regular and detailed work of drawing a horizontal section of the cliff on a large scale. I regret to say that the latter plan was never proceeded with, for the fossils proved so numerous and so varied in character that it was no easy task to fix the attention of students on the more prosaic side of the study.

Still we succeeded in establishing two facts which may have some interest for members of the section.

(1) The bone bed, more commonly spoken of as the Fish Bed, as everybody knows, is a conglomerate with a very siliceous matrix where exposed on the ledges opposite Lavernock Point.

The pebbles are of various sorts, including some impure unfossiliferous limestones, which Mr. Storrie suggested were of Silurian age. As we examined the cliff nearer the Seven Sisters, we again found the conglomerate and followed it for some distance. Here the majority of the rounded pebbles were of impure unfossiliferous limestones and the matrix was no longer characteristically siliceous, but earthy. The pebbles were in many ways, particularly in colour and hardness, very like the limestones of the Tea Green Marls exposed directly below the onglomerate.

Though not denying the fact that some of the limestone pebbles were derived from rocks of Silurian age, we suggest that in the Penarth-Lavernock cliff they consist, in the main, of limestones of Upper Triassic (Keuper) age.

There is presumptive evidence in favour of our view, for Mr. Storrie in his paper (Cardiff Nat. Trans. XIV., p. 100) states that the conglomerate "fills up hollows in the earthy limestone that caps the Tea Green Marls." Again, Lee (Rep. Brit. Ass., 1872, p. 116), describing the conglomerate of Goldcliff, near Newport, mentioned similar hollows which he attributes to "rills of running water on the Marls previously to the deposition of the bone bed." Again, the pebbles of the bone bed at Aust Passage are derived from the Tea Green Marls and Limestones of the neighbourhood.

Considering the physical geography of the Rhaetic Period, it is not easy to see where the sea margin would consist of rocks of Silurian age, including limestones of the character represented. There would be a strong probability in favour of fossils if the pebbles were derived from the Silurian limestones exposed to the north of Cardiff. Though we broke hundreds of the pebbles no trace of a fossil was ever seen.

If the suggested local source of the limestone pebbles be admitted, we have still to account for the changes in the physical geography which would permit of the denudation of deposits soon after they had been accumulated.

It is usually stated that the close of the Triassic Period in Britain was brought about by the lowering of the ridge which separated the marine area of Central Europe from the English Lake of Keuper times.

I hope, in a subsequent paper, to prove that, as a whole, the Rhaetic and Lower Lias Periods together represent one continued subsidence as far as South Wales is concerned.

By this subsidence the lake became an arm of the sea, and the Rhaetic marine fauna entered British waters. It might be that tidal currents, resulting from the union of the lake and its gulf along what is now the Severn estuary with the ocean, disturbed the waters to greater depths than in former times, scouring the bottom, and so wearing away the surface of the Tea Green Marls, giving it the water-worn appearance already described, as well as forming pebbles of the portions destroyed.

But looking at the lithological characters of the Tea Green Marls we should say that they were deposited not in shallow but in fairly deep water, and if a subsidence took place at the end of the Trias Period, the beds would be lowered much further and currents would be less likely to affect them.

If, however, we suppose that, in South Wales at least, there was a slight upheaval instead of a subsidence just at the close of the Trias Period (immediately preceding the subsidence of Rhaetic and Liassic times, about which the evidence is indisputable), we see at once that the newly-formed Trias beds might be raised into dry land and immediately

attacked by the various agents of denudation. This seems to be the theory which best explains the facts.

(2) Mr. Storrie has proved that the bone bed itself occasionally extends downwards, filling up pockets in the Tea Green Marls below. As the result of his investigations, we have always regarded the bone conglomerate as the lowest bed of the Rhaetic series in the Cardiff area. I was therefore surprised, on removing a block of the conglomerate from its natural position on the foreshore opposite Lavernock Point, to see beneath it and lying directly on a worn surface of Tea Green Marls, a thin band of black shale, not more than ¼ inch thick, containing numerous crushed specimens of typical Rhaetic shells—Cardium Rhaeticum, Avicula contorta and Pecten Valoniensis. Others may have been represented but were badly preserved.

The band of shale was very irregular, and it was only where a few square feet of the conglomerate remained, protected by seaweed from the ravages of the waves (and about the height of ordinary half spring tide), that we succeeded in obtaining specimens adhering to the under surface of the conglomerate.

The only importance that I can claim for the discovery is that the bone breccia of Lavernock Point must be henceforth distinctly described as of Rhaetic age. It is said to have many points in common with the bone bed of Goldcliff, near Newport, which, however, is succeeded by several feet of Tea Green Marls (Trias), and thus it lies well below the beds which contain the earliest remains of the typical marine Rhaetic fauna. The tendency in geological circles of late has been rather to link the basal conglomerate with the Trias than with the Rhaetic; but as true marine fossils appear below the conglomerate of Lavernock Point, and as the Triassic fauna is distinctly terrestrial or lacustrine in character, the evidence is more in favour of placing it with the Rhaetic and the Rhaetic with the Lias strata above than with the Trias beds below.

Note on Mole Cricket (Gryllotalpa Vulgaris) found by Mr. Pettigrew on Ely Common in the Summer of 1896.

By G. A. BIRKENHEAD

Read before the Biological and Geological Section on March 18th, 1897.

Order, Orthoptera; group, Saltatoria—jumpers or leapers, as distinguished from the other group, Cursoria—runners. The group Saltatoria includes crickets, locusts, and grass-hoppers.

GENERALLY.—All these insects resemble each other in the disproportion which exists between their hind legs and the other pairs. Another characteristic common to them is the song of the males, seeming to be a call to the females, and is a sort of stridulation or screeching, produced by rubbing the elytra or wing cases together, and also by passing the thighs, which have hard ridges, rapidly over the nervures of the elytra, the surface of the elytra in crickets being covered with thick hard nervures. The antennæ are long and thin.

SPECIFICALLY.—The Mole Crickets are distinguished from other insects by the structure of the forelegs, these being wide and indented, the tibiæ flattened and triangular, and terminated by four finger-like processes, having thus much the appearance of the hand of the mole. These fore limbs are short but very powerful, and are thus well adapted to the purpose of digging, the Mole Cricket having its habitation underground.

The muscular power of this insect is so great that it is said to exert a force equal to two or three pounds.

The head and thorax present a hard bony-like surface. The elytra have the strong nervures characteristic of the order, well-developed and prominently marked. The membraneous-like wings are broad and rather fragile looking; but, as will be noticed, they have a strong hard

border along the front or costal margin ; this, no doubt, acts as a great protection and gives power in flying. When the wings are closed they lie folded like a fan with this hard protecting margin outwards.

The Mole Cricket burrows under ground, raising a ridge as it advances, and forms various subterraneous passages leading to a cavity hollowed out, in which the female lays her eggs, to the number of 200 or 300, about June. Great damage is no doubt done to the crops in this burrowing process, the insect being found principally in cultured lands, kitchen gardens, nursery gardens, and such like.

The eggs hatch in from a month to six weeks' time, the larvæ continuing as such until the following spring, when they pupate and the organs of flight begin to be marked out. Maturity appears to be arrived at in the third year, thus a considerable time is required for the complete development of this insect.

The food of the Mole Cricket consists partly of vegetable substances, but chiefly of worms and insects.

One other point may be mentioned, viz., that all authors agree in extolling the solicitude with which the Mole Cricket takes care of her little ones, watching over them and even procuring them food.

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T H Thomas del.
Parker & Percy lith.

Geo West & Sons imp.

1 Male Juvencus 4 Female Gigas
2 " Gigas 5 Pupal state female Juvencus
3 " Juvencus? 6 Female Juvencus
7 & 8 Rhyssa persuasoria, (parastic).

Note on the Occurrence of Sirex Juvencus in the Society's District.

By C. T. VACHELL.

(*Read before the Biological Section.*)

IN May, 1895, my attention was directed by Mrs. Booker of Slon, Southerndown, near Bridgend, to some insect borings in pine trees in the grounds of her residence. The borings had been observed for the first time in the spring of 1895, and since, some of the bored trees were found to be dead. It was feared that the insect borings were the cause of the decay. I succeeded in finding one of the insects which had evidently come to an untimely end just as it was on the point of piercing the bark. I sent it for identification to my friend Mr. Martin Woodward—who replied as follows :—

BIOLOGICAL LABORATORY,
ROYAL COLLEGE OF SCIENCE,
S. KENSINGTON, *May 1st, 1895.*

The insect you sent me was a Hymenopterous one belonging to the Uroceridæ, the family of 'Horntails,' so-called from the prominent horn on the abdomen of the male; your specimen was a young male just emerged from the pupa stage. The female has a long ovipositor or saw like that of the true saw fly. Grub is cylindrical and fleshy white with horny tail, strong jaws for boring long holes in trunk of trees, which they inhabit, woodeaters often do great damage to firs and pines.

Female uses her long ovipositor for boring through the bark of the tree into the wood, and then deposits an egg with bore hole of half an inch in depth.

The large holes in the bark with screw like markings are the holes through which the young imago has emerged.

The name of the beast is Sirex (urocerus) Juvencus, another common form is S. Gigas, this I have caught in Somerset, it is a magnificent insect when seen flying about, and resembles a hugh wasp.

Yours truly,
MARTIN WOODWARD.

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The Pine-Wood Wasp (Sirex Juvencus) and its Occurrence at Dunraven.

By ARCHIBALD MITCHELL.

(*Read before the Biological and Geological Section on April 22nd, 1897.*)

THE circumstances under which this paper appears before you this evening demand, I think, with your permission, a few words of explanation.

On the 3rd of August last year I had the good fortune to make the acquaintance of Dr. C. T. Vachell, and during an afternoon spent in his company, I had the pleasure of pointing out to him two trees—one an Austrian Pine and the other a Scots Pine, attacked by *Sirex juvencus*.

They had been cut and laid ready for removal preparatory to their more convenient examination and the destruction of the insects contained in them, for the *Sirex*, being a serious forest pest, as such I had been in the habit of treating it. Dr. Vachell soon enlightened me as to its scientific interest, and gave me an account of the endeavours of this Society to establish with certainty the fact of its breeding in this country. Needless to say, I have since looked upon it with quite a different interest, and when Dr. Vachell very kindly suggested that my testimony as to its occurrence at Dunraven might be of use to the Society, I gladly agreed to place myself and my experience of it, meagre as it is, at your disposal.

The first time I noticed the *Sirex juvencus* was in the summer of 1894. That year I had found an attack of *Pissodes notatus*, noticed the previous year, to be more widespread than I at first had anticipated; and, with a view to exterminating the pest, I made a thorough examination of all the woods and plantations I could gain access to.

In the course of this examination I found several other forest insects, unsuspected before, and among them the *Sirex juvencus*.

That year I destroyed well over a hundred full-grown insects and larvæ, taken from the tree where I found them first. The tree was an Austrian pine, and it was in the upper part, which had been broken off in a storm, that the insects were found. I did not get all that emerged that year, for there were several exit holes to be seen in the timber when I found it; and, indeed, I saw some flying about that same day and caught one or two of them.

The insect-bearing part of the tree was burned, and the stump, about 15 or 16 feet high, left as a decoy; for as it is well known, insects much prefer a sickly tree to a sound one for the purposes of oviposition.

In 1895 I only got one specimen, and that a male, from it.

In July, 1896, bearing in mind its perhaps biennial and often multi-ennial generation, I had it and another tree, a Scots pine, about thirty yards from the first, cut for examination, as I have already said.

The Scots pine had died chiefly from an attack by *Hylurgus piniperda*, but exhibited several *Sirex* exit holes.

I may mention, that besides the extermination of the pest, I was anxious to secure a few specimens, as the ones I got at first suffered misfortune. I had arrived just as they were swarming, and had got 40 or so in a bottle; but when I came to examine them, they were of little use as specimens, owing to their apparent determination to enact the story of the Kilkenny cats over again.

Of the complete insects I afterwards got, some I sent to Dr. Somerville, Professor of Agriculture and Forestry at Durham College of Science, Newcastle-on-Tyne, for identification, some I sent to friends, and others were eaten by mice.

The *Sirex juvencus*, or Pine-Wood Wasp, belongs to the order *Hymenoptera*, and the family of the Wood Wasps, or *Uroceridæ* or *Siricidæ*, which from the point of view of Forest Entomology, are technically injurious insects—*i.e.*, insects which destroy the technical value of the timber by their large larvæ boring deeply into the wood and rendering it unfit for many purposes. They only attack coniferous timber.

Miss Ormerod, in her "Manual of Injurious Insects," describes it thus:—"The female is commonly blue-black, with rusty-red thighs, "and reddish shanks and feet, black horns, and somewhat brownish "transparent wings, with rusty veins, and spot on the fore wings. "The male is blue-black; abdomen, with margin of the third, and "the whole of the four following segments red; the hinder shanks and "feet dilated and compressed and dark blue."

Such is Miss Ormerod's description; but in all the specimens I have seen, the two posterior segments of the abdomen of the male are blue-black like the rest of the body, and thus they agree with the description given in Fürst's "Protection of Woodlands."

Miss Ormerod says, further, that both sexes vary in amount of red or black on the legs; also sometimes the prevailing blue tint is varied by

a greenish colour; and she also notes a difference in the colouring of the antennæ, saying the six lower joints may be red, whereas, in the specimens before us, I have seen none other than black antennæ on both male and female.*

As might be expected from their primary mode of life and place of abode, their jaws are very strong. The terminal segment in both sexes ends in a point, that of the male being sharp and sting-like, while the distinctive feature of the female is the long ovipositor springing from beneath the seventh segment of the abdomen and stretching under the insect right past the tail. It lies in a sheath, which can be opened longitudinally to allow the ovipositor to be used if necessary in a position at right angles to the body of the insect.

In the largest insects it often reaches a length of five-eights of an inch, and is capable of boring right through the cortex and well into the timber. The deepest boring I have seen is half an inch, including one-eighth of an inch of bark.

I have never seen the insect engaged in the process of oviposition, but I should think from the notched appearance of the ovipositor that the action is saw-like.

The eggs are deposited singly. The usual depth for the most successful hatching of the larvæ seems to be about a quarter of an inch, or slightly over that, including the bark: that is, in the second or third layer of timber from the exterior. I have examined many of the oviposition holes, and only in the comparatively shallow ones have I discovered any appearance of the bore dust of the larvæ; of course, it is possible that the deeper and abortive holes may have contained no eggs.

The holes are usually, though not always, bored straight inwards towards the centre of the tree, and appear singly or in groups of from two to four on the removal of the dead bark as small punctures with a collar raised above the surface of the wood, probably the result of the accumulation of bore dust between the cortex and the timber when oviposition takes place.

At first the boring of the larvæ is usually directed either up or down the tree. Only once have I seen any marked deviation to one side.

The newly-hatched insect usually begins to bore at about right angles to the oviposition hole, and proceeds in a nearly straight line, keeping to the zone of timber the egg was deposited in.

After proceeding for about from three-eighths to three-fourths of an inch, and increasing rapidly in bulk meanwhile, it turns in towards the heart of the tree at an angle of from 25 to 50 degrees. It then proceeds in a straight line for about an inch and then all regularity of direction ceases. It seems to bore every way, often turning with a very short radius, intermixing with, and sometimes even crossing the boreholes of its brother larvæ in such confusion that I have not yet been able to follow one right to the exit.

* See Mr. MacDougall's Note.

The larvæ are whitish, soft, and cylindrical, with scaly heads, furnished with strong jaws. The three pairs of feet are very small, and at the upper portion of the rounded tail extremity there is a blunt point or spine. They fit the boring exactly.

The pupating chamber lies at any angle to the circumference, and at a depth of from three-fourths to three-and-a-half inches.

The duration of the larval and pupal states seems very uncertain. According to Miss Ormerod the "larvæ are full grown in about seven "weeks, and then, or later, they change to chrysalids in the tree. The "pupa resembles the perfect insect, lying still, soft, and white, with the "limbs laid along the breast and body." She says, further, that the insect may be completed in a month, or it may not be completed till the following summer, or even till a much later period.

Fürst says the generation is biennial at least, and that in the spring following the second winter it bores its way towards the surface of the trunk for the purpose of forming a pupal chamber in the sapwood, and issues in the midsummer following.

How far these authorities are right I have had no means of ascertaining. They are both, however, agreed that the generation is sometimes longer, for cases have been known where the adult insects have come out of timber which has been worked up into beams and scantlings for some length of time.

The size of the adult insects varies very much, and it is quite common to find a specimen less than an inch long emerging only an inch or two from one an inch and a half or an inch and three-quarters in length. The spread of the wings varies from three quarters of an inch to two and an eighth inches.

The males are, as a rule, smaller than the females. Miss Ormerod thinks that the conditions under which the larvæ reach maturity may have something to do with the variation in size, and cites a case where she had a male specimen just under half an inch long, and a female five-eighths, including the ovipositor, from some buried wood used for supporting drain pipes.

While not questioning the accuracy of her conclusions in that case, I cannot but think that there must be some other reason why these insects, living in the same log, under the same conditions of life, and emerging at the same time, should exhibit such a marked discrepancy as to size. I have a specimen, a male, just under three quarters of an inch, taken from the same log as others of the large sizes just quoted, their conditions of growth being exactly similar, and seemingly all that could be desired. The thickness of the timber seems to make no difference.

However it may be, I have thought that the large-sized ones, emerging at the same time as the small ones, may be, perhaps, a year or even more older, for I have noticed that it is only larvæ of large size that remain for the after swarming. This can scarcely be correct, for between July 2nd and 10th specimens from half inch to one inch and a quarter have emerged from the logs from which the specimens

were obtained last year. At the same time I think we should not lose sight of the possibility and also the probability of the size of the progeny being affected by the size of their parents, as it is in other branches of the animal kingdom.

And now as to the fact of its breeding in this country. That is a point which it is not mine to decide. It simply remains for me to give you the facts of the occurrence of the insects as I have found them at Dunraven.

I have told you how I found them in three successive years, twice in large numbers. Last year, Dr. Vachell and other members of this Society, had an opportunity of witnessing their emergence from the timber.

Some time ago a specimen was found at Slon.

In the winter that has just gone I have had extended opportunities for examining trees containing them, and have found larvæ and bore-holes in no fewer than thirteen trees, and these, not in a single group, but spread over the woods.

The trees were Austrian pine, Scots pine and larch. The larch I have since found contained *Sirex gigas*, and from the appearance of the timber and the bore holes, many of them may have been attacked for some time previous to my first discovery of the insect.

Whatever may have been the origin of the occurrence, it certainly cannot have been augmented from the driftwood on the sea shore these last three years, as I have examined all the driftwood in the vicinity for that time, to try and exterminate another insect pest which is doing much damage to our young plantations; and I have seen no sign of the *Sirex* except three or four exit holes in one log, and it was speedily removed.

I am well aware my paper comes far short of completeness, and I am only too sorry I have had few opportunities for consulting authorities or for making more detailed observations.

Notes on the Flora of Wales.

By C. T. VACHELL, M.D.

Read before the Biological and Geological Section on April 22nd, 1897.

THE compilation of a Flora, embracing the whole of Wales, is a task which yet remains to be accomplished—but a valuable contribution towards this end is to be found, very curiously, in an Appendix, or series of Appendices, to the Report of the Royal Commission on Land in Wales and Monmouthshire, 1896, pages 140-145.

Under the title of "Supplemental Notes on the Bibliography of the Natural History of Wales" is to be found, first, an account of the Bibliography of the Fauna of Wales, and following this is given a similar report of the Flora of Wales.

Had this completed the botanical references it would not have been necessary to call attention to the matter in these pages; save, perhaps, for the purpose of highly commending the article to the favourable notice of our members; but there is inserted at the close of the article what purports to be a list of "The Rare Plants of Wales," and to this it is necessary to take exception, if only to mention that out of a total of 58 plants which are enumerated, only three are given as occurring in South Wales, the remainder having North Wales habitats assigned to them. The natural inference would be that South Wales was lacking in rare plants.

The paper would, indeed, have been more correctly styled the Rare Plants of North Wales, and even so, it could not be admitted that the plants enumerated formed a complete list of the rare plants to be found in North Wales,—or, indeed, that by any means all of the plants mentioned are rare at all,—thus, for instance, Trollius europæus is included in the list; whereas in the London Catalogue of Plants it is said to occur in 63 counties out of a total of 112; Campanula

Heridacea is another, it occurs in 46 counties; Vicia Orobus occurs in 34; Saxifraga oppositifolia occurs in 30; Harbenaria albida in 48; Scirpus rufus in 47; Asplenium viride in 46; Lastrea recurva in 37, etc.

An analysis of the list shows that the rarity of two plants is not stated; six are recorded as occurring in one county only; these may be said to be very rare; two occur in two counties; one in three; one in four; two in six; four in seven; two in nine; two in ten; and one in eleven. All these would be rare plants. After this comes one plant found in thirteen counties; two in fourteen; one in sixteen; four in seventeen; and three in nineteen; and these may be described as moderately rare. This gives a total of 34 out of the 58 plants, and of the remaining 24 two are excluded species; two are aliens; 12 occur in from 20 to 30 counties; three in 30 to 40; four in 40 to 50, and one in as many as 63 counties.

Had our Society been consulted we could have added to the list an interesting series, comprising, amongst others—

Draba azoides (1).
Antennaria margaritacea.
Helleborus foetidus (16).
Aconitum napellus (7).
Lithospermum purpureo—cæruleum (8).
Adiantum Capillus—Veneris (4).
Trichomanes radicans (4).
Primula elatior (6).
Meconopsis cambrica (14).
Scrophularia Scorodonia (4), etc.
Senecio vulgaris v. radiatus.

Pæonia corallina, Allium Ampeloprasum, and Oenothera biennis, are excluded as being only naturalized aliens.

Stray Notes on Natural History.

By R. DRANE, F.L.S.

A Wheatear's Nest was found, with six eggs, under a "sleeper" on the Taff Vale Railway, over which trains were frequently running, and a nest of the Common Sandpiper was found at Taff Vawr, containing four eggs, about ten feet from the water's edge, in a small hollow under a dead stump. This was on May 19th, 1897; weather cold, with a slight fall of snow.—T.W.P.

A Blue Tit's Nest was removed from the fresh-air inlet pipe of the house drain at 197, Newport Road. The pipe, four inches diameter, was fixed upright against the garden wall, and its mouth closed with a wire guard. The nest filled the pipe, was placed three feet from its mouth, and consisted of moss and wool. May 24th.—T.W.P. How was the *first* piece of moss or wool placed and retained in position? The fact recorded is neither disputed *nor explained*.—R.D.

Another Blue Tit built its nest and hatched nine young ones in the pedestal of a flower vase on the lawn at Ty Mynydd, Radyr. The pedestal was thirteen inches high, hollow, and having a two-inch opening at the top, through which the bird entered. The nest was placed on the ground at the bottom. May 22nd, 1897.—T.W.P.

Blue Tits. I have noticed several pair building this year, as usual, inside the pillars of the street gas lamps. 1897.—T.W.P.

Corn-Bunting (*E. miliarid*). I saw this bird on the Dinas Powis Moors on June 30th. It was very tame, and from its action it led me to believe that its nest was close by.—T.W.P.

Blue Tits. I have seen a pair of Blue tits persistently try to build in the spout of a pump in frequent daily use. They carried in incredible quantities of green moss, which had to be pumped out before any water could be obtained for use; but, nothing daunted, they went on for a

fortnight, and were so troublesome that they had to be excluded by netting. They then entered the upper part of the pump by the opening through which the handle worked, and were with difficulty prevented. The pump was about twelve feet from the kitchen door, over which was a weather-hood; in this hood an old shoe had been placed, and when the use of the pump was denied them, the birds took possession of the shoe, in which they built their nest and brought up their young in peace. These birds are infinitely entertaining and affectionate cage pets. They soon lay aside all fear, adopt their cage as their home, and will return to it when allowed their liberty.

RATS. When the pavement was being renewed in St. Mary Street this summer, a rat's nest was found under one of the flag stones, containing half-grown young ones, within six inches of the surface, upon which there was constant and great traffic.

NIGHTINGALES have been much more numerous than usual for two or three years past within our district. Mr. T. W. Proger heard them for the first time this year on April 28th, at Cwm Barry. They were also heard nearly every evening at Cogan, Leckwith, Colcot, Dinas Powis, Llandaff, Penylan, St. Mellons, &c., &c., and nests were found at Llandaff and Sully. They seem somewhat capricious birds, frequenting for a time, and then suddenly deserting a district without visible or assignable cause. Forty years ago they were fairly numerous about Leckwith, then followed a period within which they were rarely heard, now they re-visit us in unusual numbers spread over a much larger area.

PIED FLYCATCHER. A specimen was shot at Michaelston-y-Vedw on April 20th. I saw and examined it while fresh, and Mr. T. W. Proger tried to induce its possessor to add it to our Cardiff Museum Collection to which, *as locally taken*, it would have been a very desirable addition. It is not uncommon in some districts, but I do not remember its occurrence within our area before.

HOUSE MARTIN. This elegant, delightful, and innocent bird grows rarer year by year, due, probably, to the habit of the vulgar, mischievous, and useless sparrow taking possession of its warm and beautiful nests as soon as complete, and appropriating them entirely to their own use—the "people" ousting the "old aristocracy"—*Vox populi, Vox Dei.* Jerry builders absorbing parks, and millionaires appropriating grouse moors—whatever is, is right; but right is not always wholly agreeable.

HARES. One of two hares kept in captivity, but allowed the run of the house as freely as cats, and almost entirely unrestrained, produced a litter of three young ones on May 8th, but, shortly after birth, killed all of them, and entirely ate two. These hares might escape if they chose, but shew no disposition to do so. On one occasion one of them got upon the roof of the house, and it was feared it would stray to adjoining roofs and be lost, but it returned of its own accord. Both parents were about one year old. They differ very much in character,

disposition, and tastes, but both are very fond of sweet chestnuts, milk, and Huntley and Palmer's biscuits, though they mainly live on carrots, bran, and green vegetables, generally shewing infinite relish in any variant of these last, but they will not touch turnips. They like brown paper, and the woollen pile of thick carpets, eating it down to the bare hempen substructure. They are only too fond of the leather part of skin mats, so they are not "entirely vegetable feeders." On July 23rd the same hare produced two more young ones, and again the mother destroyed and partially ate both of them.

Cuckoo. The Cuckoo was heard on the 15th of June repeatedly to cry "cook-cook-oo." It would be well if members would note and record the precise date at which this change of utterance occurs, for it seems probable that a great many birds adopt a change of voice at, or shortly after, the hatching of their young.

Man. The President of the Society was introduced to one of its public lecturers in a manner which elicited the remark, "I hope you are duly impressed with the august presence in which you find yourself," and the reply given, with marked emphasis, "No, I am *not* at all," and the rejoinder, "God seems to have endowed you with a keen sense of humour," while, from under the table was heard a——? a mew! which indicated that "an inferior creature" had grasped the situation.

Woodcock. On May 21st, a Woodcock was brought me, which had just been killed near Cardiff. It was quite fresh, and weighed eight and a quarter ounces. It had probably stayed to breed, but the intelligent benevolent sportsman intervened.

Dormouse. The natural food of this creature is nuts, acorns, and crab apples, in winter, but, like all other creatures, it varies in taste and character. One in confinement lived largely on bread and milk, apples, and nuts. Another would eat neither apples nor bread and milk, but was fond of grapes. Neither would touch corn of any kind, and, though fond of almonds, walnuts, and Brazil nuts, would not eat chestnuts nor acorns. One in captivity went to sleep on July 7th, and did not wake again till the 14th; during the whole of this interval it was as cold as in mid-winter. Is it generally known that they thus become dormant and cold in the *summer* months?

Squirrel. One in confinement, and extremely tame, would lick its owner's hand or cheek persistently, and emit a singular little grunting noise, very indicative of content and happiness, if not affection, and, when in bed, and apparently asleep, had a habit of grinding its teeth. This habit, which is also noticeable in the hare, is more probably the agency by which the cutting edges of the teeth are kept in order than their use in knawing. Nothing can exceed the trustful affection of which this creature is capable, but when will man extend to it the love it is ready to bestow? I am told that roast squirrel is excellent eating!

Rooks. Will any member take note of the movements of Rooks from place to place throughout the year, and record the result in the next

issue of the Transactions? When or why do they frequent or leave their own special rookeries, and where do they sleep when not at home?

SIREX. A female Sirex Gigas emerged, on June 23rd, from one of seven blocks of timber kept under observation, and which are known to be filled with the larvæ of Sirex Juvencus. No Juvencus has yet appeared, and Gigas was not expected. June 29th, 1897. Is Gigas really an earlier species, and do its females, like those of Juvencus, emerge at slightly different (though overlapping) periods from the males? Please observe and communicate.

PUFFIN. This bird leaves its Welsh breeding ground about the middle of August, but on Sept. 1st I took a young one covered with its sooty down. I saw only two or three adult birds where less than a month before there were thousands.

SHEARWATER (*P. anglosum*). I found these birds still plentiful at their breeding ground. August 28th to Sept. 1st; coming out of their burrows after dark and flying very low. In as many minutes I took three by hand easily. These nights were windy and wet and on none of them did I once hear this bird's characteristic cry.—R.D.

"Mari Lwyd" and its Origin.

By The Rev. W. ROBERTS (Nefydd).

Translated from the Welsh by W. Eilir Evans.

The following article consists of lengthy quotations from a work written by the Rev. W. Roberts (Nefydd), a Baptist minister and antiquary of some standing, which form part of a book published in the year 1852. A large portion of the original is polemic in character, this essay having for its object the dissuasion of the inhabitants of Wales from observing the customs described. "Nefydd's" descriptions of the customs in Wales are very full and accurate, and he must be looked upon as perhaps the first writer who appreciated their significance from the point of view of the student of folk-lore. The translation has been carefully done by Mr. W. Eilir Evans, at the request of Alderman Richard Cory, J.P., to whom the Society is indebted for permission to publish it.

"Certain traditions, superstitions, amusements and forms will be maintained hereditarily, without even a knowledge of, or respect to, their origin, but merely as customary, by the lower order."—(*Rev. P. Roberts' Popular Antiquities.*)

WITHOUT endeavouring to state the different views concerning the origin of Mari Lwyd which have recently appeared in the press,* I shall proceed to give what seems to be the more probable origin of the custom, a custom as to the beginning of which history has little definite to say. Roberts himself does not state its origin.

It is our object directly to prove that Mari Lwyd is but a relic of the dramas which were at one time performed under the sanction of the Roman Catholic Church, and it would seem that many other Welsh customs might also be traced to the same age.

* "Seren Gomer," "Monmouthshire Merlin," &c., &c.

It is well known that many dramatical compositions were formerly acted, several of which have survived to quite recent times, such as the "Mysteries of Coventry and Chester." Doubtless such interludes as these formerly existed in Wales, indeed the Rev. P. Roberts, the writer of the "Popular Antiquities of Wales," goes so far as to suggest that the story of Uthr Pendragon's transmigration by Merlin * is a kind of interlude. He also infers that the feast given by Cadwgan ab Bleddyn, in the year 1107, at Christmastide (*vide* Carnhuanawc, pp. 614 and 531), and the feast of Gruffydd ab Rhys, at Ystrad Tywi, in 1135, were held with a similar object. But it is more reasonable to suppose that those were more like Eisteddfodau, or literary meetings, at which also physical recreation was indulged in.

In the 12th century the Welsh were famous as poets, minstrels, and for their study of nature, as may be seen from portions of the work of Grialdus Cambrensis.

In the writings of W. Hone, a comprehensive account is given of the mediæval dramas. The reader may consult Hone's book on "Ancient Mysteries and Religious Shows," published in 1822.

It is supposed that these dramas originated in a desire to bring religion to the level of the masses, with a view to their instruction rather than amusement. In Greece dramatic representation reached a high pitch of excellence, and it is probable that the first Christian religious drama was composed by Gregory Nazianzen, when he was Archbishop of Constantinople.

The ancient "Fathers" were strongly averse to the classic Greek plays, and condemned and excommunicated those who patronised them. Tertuilian says that "those who in their baptism renounce the devil, with his vanities, become apostates when they appear on the stage." It is supposed that the archbishop's object, in providing scriptural dramas, was to counteract the popular effects of the Greek plays of Sophocles, Euripides, and others. One of Gregory's dramas is still extant; it is a tragedy on "Christ's Passion," in which the Virgin, or the Blessed Mary (Mari Lwyd), form one of the characters. It is said that Gregory succeeded in stemming the influence of the Greek stage by providing comedies and tragedies, based on scriptural events for the people's diversion, and that these were performed in public.†

But acting, as a means of inculcating doctrines held by the Church, as already stated, was introduced in opposition to the pagan plays, and spread widely, and continued in use from Gregory's time up to a few centuries ago. Several customs still in vogue among us may be relics of those times. As regards dramas of this nature still extant, and which go under the name of "Mysteries." The Mysteries of Coventry are forty in number, and the Mysteries of Chester twenty-four. Dugdale, in a

* *Vide* "Enderbie's Camb. Triumphans," p. 185, and "Roberts' Antiquities," p. 137.

† "Ribadeneira's Lives," Vol. I., p. 333. "Leclere Lives," Vol. VIII., p. 289.

work published in 1656, * says: "Before the destruction of the monasteries, this city (Coventry), was famous for its plays on Corpus Christi Day, which caused multitudes of people to gather together from far and near; the acting was done by the Grey Friars, who had large and tall theatres on wheels, so as to move hither and thither in the city for the convenience of the onlookers. They consisted of Old and New Testament histories, set in rhyming dialogue, as may be seen in the old manuscript (Bibl. Cotton. Vesp. D. VIII.) called Ludus Corpus Christi, or Ludus Coventriæ." We find that there was a large influx of people to Coventry at the time these plays were acted. Richard III. was a spectator at the feast of Corpus Christi held there in 1483. Henry VII. and his consort visited Coventry for a similar purpose in 1492. The Mysteries of Chester, says a distinguished historian of that district,† were acted up to the time of the Reformation, the last time being in 1574. Williams, in his history of Monmouthshire, surmises that Sion Cent became famous for the part he played in religious dramas, and that the stories concerning him and the devil thus originated (Williams's, p. 231). W. Hone has published a few of these dramas as specimens. Those now before me are eight in number, all referring to the birth of the Virgin Mary and of Christ as set forth in the Apocryphal gospels more especially. These were published by W. Hone, in 1820. The first mystery treats of the birth of Mary; the second of her teaching in the Temple and the ministering of angels unto her; the third takes up the miraculous betrothal of Joseph to Mary; the fourth gives the Counsel of the Trinity regarding the incarnation; the fifth, Joseph's intention to put Mary away privily; the sixth, Mary's visit to Elizabeth; the seventh, the Trial of Mary and Joseph; and the eighth, Jesus's miraculous birth in a manger.

I believe the "Mari Lwyd" originated in these mystery-plays, the word *llwyd* being often used in the sense of blessed, as may be seen from the following instances:—

"*Llwydion* fu'r saint, geraint gu,
Disyml, a *llwyd* yw Iesu."
—*Rhys Goch Eryri.*

"Mynd, er gwann, i'r mwyndir goed,
Mae yn dy law, mynn Duw *lwyd*."
—*William Lleyn.*

"A chywyddau i Dduw *lwyd*
Yw Llaswyr Dafydd Brophwyd."
—*Dafydd ap Gwilym.*

"Rhad Duw a Chynoran *lwyd* ar y da—The grace of God and the blessed Cynoran on the cattle—was an ejaculation made use of in offering at the well of Cynoran, at Llysfaen, on behalf of deceased cattle."—("*Cambrian Biography*," sub. loc., "Cynoran.").

In the copy of the Cambrian Biography, owned by Iolo Morganwg and Taliesin ab Iolo, opposite the above quotation, a marginal note,

* "Dugdale's Warwickshire," p. 116. † "Ormerod's History of Cheshire."

written by one of the two, reads as follows—"Llwyd, blessed, hence Duw lwyd, etc." This will suffice, by way of illustrating the former meaning of the word, though it would be easy to multiply instances from the works of the Welsh bards to prove that it was then used. The works of the bards from the earliest times to the Reformation are full of apostrophies to the Virgin as "Mair."

Certain feasts, which may seem connected with the Mari Lwyd, were established, one was called Feast of Fools, and the other Feast of the Ass, in the year 990, by Theophylact, Patriarch of Constantinople.* Beletus states that the Feast of Fools was held in some places on New Year's Day, and in others on the 12th of January, while in some it was observed the following week. These feasts were held in the most amusing manner. In France it was observed as follows—The "Bishop," or the "Archbishop of Fools" was appointed and in the neighbourhood adjoining the metropolitan see, the "Pope of Fools" was elected. These had their proper official vestments, and made gestures on the stage, opposite the church, before the people. Their conversation and gestures were highly unbecoming; their faces were blackened. Some appeared in female attire and made coarse and lewd signs; sang immoral songs; ate pudding at the end of the altar, played at dice close to the priest when celebrating mass, censed him with the smoke of old burnt shoes, running and leaping in church. The Bishop or Pope of Fools, while celebrating, was robed in priestly vestments, and when he had finished he was placed in an open carriage drawn by a throng of clergy and laity, who threw mud and dirt over the bystanders. Is must be recollected that those were the ages, very properly called "dark."

Consequently, Gregory (Bishop of Neocaesarea, who died in 265) established holy days or feasts in memory of saints and martyrs, in lieu of the feasts of the pagans, in order to facilitate their conversion. The christian feasts, therefore, were held instead of the pagan feasts, and grew like unto them, such as the observing of Christmas with joy and merriment, eating and drinking, and every kind of mirth and amusement, instead of the Bacchanalia and the Saturnalia, the first of May with flowers, instead of the pagan Floralia, and the feasts of the Virgin, John the Baptist, and several of the Apostles, instead of heathen institutions on the appearance of the sun in the different signs of the Zodiac.†

Some sections of the priesthood went so far in its observance of feasts of this kind in imitation of pagan practices, that Boniface is said to have "complained of certain German priests, who, though professing Christianity, sacrificed bulls and goats to heathen gods."

The tenor of Pope Gregory's letters to Milletus, the abbot, on the eve of dispatching for Britain, in the sixth century, is to the same effect. Milletus is enjoined to instruct Augustine, Archbishop of Canterbury, that "he (Gregory) having given much thought to the case of Britain, adjudged that the temples of the idols, which that nation

* "Warton," II., 369. † "Turner's History of England," Vol. II., p. 340.

possessed, should not be destroyed, but be sprinkled with holy water, and certain relics deposited in them. Also, inasmuch as the ancestors of the people sacrificed oxen, they be permitted to slay kine or oxen, and build huts of the branches of the trees that grew around the temples, on the day of the dedication of the latter, which were the birthdays of the martyrs and saints, whose relics the temples contained, and hold a comfortable religious feast."*

The above quotations illustrate the beginning of several feasts and customs which are still, to some extent, in vogue, but were once more so up to a recent period in the Principality. We find the origin of our May-day festivities in the pagan Floralia. It is from those we have the floral decorations, the rosettes, the ribands, and the summer dances of the North, the bearing of the may-pole, the lifting of the birch-bough in South Wales and in England. We will now confine our remarks to the feast of Christmas, though it will be necessary to notice now and again how customs have been shifted from one part of the year to another in some districts, while they are only occasionally observed in some localities. Christmastide commenced on Christmas eve, and sometimes extended over a fortnight, and at some periods we find that the holy season was kept up during December, January, and February. It was during this season mystery plays were acted, feasts given, and sports and festivities of various kinds indulged in. Now were held the Feast of Fools, already described, the Feast of the Ass, the Boy Bishop, besides the religious interludes before referred to. We now proceed to describe briefly the Boy Bishop and Feast of the Ass, which had some features in common with the Feast of Fools. It was in the Feast of the Ass, more particularly, our institution of Mari Lwyd originated.

The Boy Bishop was elected as were his two deacons. He was escorted to church, wearing a mitre, by a choir of boys, where he officiated at a sham service. Thence he and the deacons went from door to door to collect money—not to beg for it as charity, but to demand it as a right. The bishop was elected on December 6th, and held office until the 28th, or Innocents' Day. It would be too long a task to notice everything that took place on these occasions, but some discription is necessary by way of explanation. The feast and the boys were under the protection of St. Nicholas, by reason of the miracle attributed to the saint of bringing to life again the bodies of young boys who had been killed and hacked to pieces. This custom was observed in this country for about six hundred years, and such sanction was given to it by the church, that it was an honourable and legitimate feature of our religious life. Every respect was paid to the bishop as to a real bishop, when alive and at his funeral when dead. Sometimes beautiful effigies in marble were raised to the memories of these bishops, some of which are still extant.† This parody was prohibited

* "Bide's Eccles. History of England," Vol. VIII., p. 94.
† "Brand," Vol. I., p. 332.

by Henry VIII., and again by Elizabeth. Then commenced the practice of playing soldiers, and the election of captain and other matters were proceeded with. But as this latter custom was not under the ægis either of the church or the state, it naturally declined by degrees, and in many places it has died out completely. But in Gwent it is now almost as well known and flourishing as in the time of Henry VIII. In North Wales, and other parts of the Principality, not to mention England, nothing of it remains save that children go about asking for gifts, and collect half-pence from door to door. In some places this is done on New Year's Day, in other places on any day within the season. It helps to show that Gwent and Morganwg are more tenacious of ancient customs than any other portion, not only of Wales, but of the kingdom, as will be seen in the case again in the Feast of the Ass, which is the original, it would appear, of Mari Lwyd.

In the course of the year, there are three Feasts of the Ass, especially in Gwent and Morganwg. One commonly observed is Flowering Sunday, in memory of Christ riding on an ass to Jerusalem.* In observing this feast formerly it used to be the custom to prepare a wooden ass, on which was placed an image. This was then placed on a stage, which was moved about on wheels, and decorated with branches and flowers. The stage with its contents was then drawn towards the church by the people, going in procession and carrying branches in their hands. On arriving at the church door they were met by the priest, who blessed the branches. The branches were henceforth looked upon as a protection against losses from tempests that year in the case of those who carried them. Then the priest bowed himself before the wooden ass, lay on his face until another priest appeared touching him with a long rod. On his rising up, two other priests fell down and sang a chant in that posture. Then they would all rise up, and took the stage with the ass to church, where the ceremony was completed. Another Feast of the Ass commemorates the ass of Balaam. That was held at Christmastide. A third was in memory of the flight of Joseph and Mary with the young child into Egypt, also held at Christmas on the 14th of January. These last two in course of time became mixed up in some respects. The latter of the two was originally held as follows:—To represent Mary and her son, they sought the fairest female they could find, with a pretty child in her arms. The virgin and the child were placed on the back of an ass, the animal being prettily dressed. The female preceded the bishop and priests in a procession to church and to the altar. Mass was then celebrated, and at the close of each petition, gloria patri, and the creed, &c., the people would say, Hiu hau, hiu hau, in imitation of the braying of an ass. The priest, instead of saying "Ita missa est," at the close of the mass, ended by singing three times, Hiu hau, hiu hau, hiu hau, and verses were sung during the service in honour of the ass. The music was purposely irregular, wine was drunk, and given to the ass, and dancing

* "Brand," Vol. I., p. 107.

took place around it. Then, having well feasted, the ceremony was completed by acting one of the mysteries already referred to.

This, methinks, was the origin of what is now called Mari Lwyd. The above feasts were recently held in other countries, and we read how the Feast of the Ass was celebrated pretty much in the above manner in Ireland a few years ago. A beautiful woman represented Mary, with a comely child in her arms, riding on an ass, and a religious service of some sort performed.

It would seem that Mari Lwyd contains mixed features of the Feast of Balaam's Ass and the Feast of the Flight into Egypt, with the religious acting referred to already. The now "blessed" (llwyd) compels us to take the virgin into consideration. Again the fact that the ass's, or rather in recent times the horse's head. The head used in former times was that of an ass, within the recollection of many old people still alive, but on account of the scarcity of asses' heads it became necessary to use what most closely resembled an ass's head, and then the horse's head came in. The fact that this head talks in the play, compels us to believe also that Balaam's ass was originally a feature. Again, the dialogue employed by the different characters reminds one of the presence of the mystery element in Mari Lwyd. Possibly the following quotations from the *Builder*, for July 31, 1847, will convey some further idea of the religious plays refered to, as well as the vestments and instruments employed. These plays were so popular that all expenses were defrayed by the corporation. Sharp, the distinguished antiquary, in course of his investigations, came across some old accounts belonging to the Corportaion of Coventry. He gives several quotations which throw light on the mode of conducting pageants in those days, and states they contained some items too immoral for publication. The following quotation shows that the corporation paid a salary to the actors, according to their ability, possibly :—

Item—paide to the sprytt of God, xvjd.
Item—payd to the ij angelles, vujd.
Item—payd to the demon, xvjd.

It may be the following refer to the play of the judgment :—

Item—payd to uj white soules, vujd.
Item—payd to uj blakke soules, ijs.

Thus the "blakke soules" got more than the others.

Item—to ij sprytts, xvjd.
Item—payd ij wormes of conscience, xvj.

In 1573 the player's name is mentioned who represented two characters in the same drama :—

Payd to Fawston for hanging Judas, iiijd.
Pd. to Fawston for coc-croying, iiijd.

In 1578 we have :—

Pd. for a new hoke to hang Judas, vjd.

A curious item this :—

Item—for mendyng the deville's cote.

Also,

Item—for making the sollys cottys, ujd.
Item—for the spritts of God's cote, ijd.
Item—a hat for Pilate.
Item—for mendynge the devyls hede.

In 1477 :—

Item—for mendyng the demons garment.
Item—payd for a stage for the demon, iiijd.

In 1480 :—

Item—payd for mendyng Pilats hat, iiij.
Payd for mendyng the wynde, ijd.
Payd for a new roppe for the wynd, viijd.

Again :—

Payd for iiij pare of angyllys wynges, ijd.

There are instances of these plays being performed as late as 1817 and 1822 in different places, but maybe the above quotations will suffice on this head. Though it became necessary to leave out the religious character of these plays in this country, yet the people would not let go the amusement they afforded, and they were turned into secular observances, as we have already seen.

The well-known institution Mari Lwyd has nowhere been kept in Wales so like the original as in Gwent and Morganwg, assuming one's supposition as to its source to be correct. In other districts of Wales we only find a few indistinct traces of the thing. Looking to North Wales, all we find there as having relation to Mari Lwyd is the custom of "giving a skull," as it is there called, which is as follows :—Young men go in search of a horse's or an old ass's head. The latter is preferable if it can be found. If there be a woman to whom they wish to show incivility, or on whom wish to wreak vengeance for some unkindness, the horse or the ass's head (as it chances to be) is hung up in some place by the time she gets up on the first of May. Unless matters turn out successful by that date, the ceremony is delayed until May Day, a fortnight later. Sometimes the skull is put up on the door, at other times over above it. Generally, the men folk are up early on that day in order to find whether a skull has been left for a woman or for the women there, and read the name or names it heads, lest the woman gets about first and throw the skull away, and spoil the whole game. Having discovered that a skull has been left, the fact excites merriment and laughter to the whole company, family, or neighbourhood at the expense of the woman or women who may have been unfortunate enough to have been presented with a skull. Sometimes several skulls are found at one house, all intended for the same woman. But when a young man wishes to show his respect and kindness to a woman, he prepares a bouquet of pretty flowers, which he places in some convenient place above the door, as in the case of the skull, that the bonnie lass who is thus the object of affection

may find it on the morrow. It would appear that it was from Mari Lwyd or the Feast of the Ass this curious custom of giving a skull must have been derived, and that the giving of a she ass's skull at first signified a taunt or charge of some shameful practices on the part of the woman. The skull represented the Virgin Mary, Mari Lwyd pure and holy, as contra-distinguished from all impurity, unchastity, or any other uncleanness, and in strong contrast to the woman who becomes the object of disrespect. Also it would seem that the date was changed from Christmas to May Day in order (it being the season of the floralia) to get a time of year convenient at once to express honour by the giving of flowers, and dishonour by the presentation of the skull, thus emphasising the distinction made by the contrast that is between the two.

Looking at matters in other districts in the Principality, Dyfed, which contains the counties of Carmarthen, Cardigan, and Pembroke or Radnor, and the extreme point of Brecknock, contains but few traces of Mari Lwyd, or any of the feasts mentioned above. There we find the wooden horse brought into use to mark infidelity on the part of the husband or the wife. Doubtless the idea sprang from the same source as the skull custom in North Wales; Mary, on account of her purity, being placed in contrast with the publicly immoral, or those thought to be so.

The wooden horse ceremony is performed in this manner:—Having discovered that conjugal infidelity exists in the neighbourhood, without waiting for a certain fixed season of the year, such as Christmastide or May Day, to notify the fact, the intended disrespect is shown as soon as possible. A wooden horse is prepared, a number of people congregate together, bringing with them all the necessary instruments, such as old frying-pans, and tin vessels, horns to blow in, with everything calculated to make sufficient noise, so as to give publicity to the disgrace of the offenders. We seem to see the crowd now approaching the house of the guilty party, armed with all the implements above mentioned. The evil-doer has already seen them coming, who, feeling guilty and aware of the custom, needs no prophet to tell him the purport of this visit of the populace who have come to do him "honour." However, he is determined to bolt and secure the door, so that not a living soul can come in. But the friends are not to be thus defeated in their object. They make for the door, burst it open, and bring out the culprit, whom they set on the back of the wooden horse. Some person known for his wit and eloquence is appointed spokesman, whose duty it becomes to relate the sins of the fellow who sits on his wooden horse in a conspicuous place. Then the din commences, in one clamorous chorus, no matter whether grave or gay the character of the rattle and noise of the vessels and the horns, all that is cared for is the quantity and not the quality of the hubbub. The tin vessels are beaten furiously and the blasts of the horns are terrible. The procession wends its way through the principal streets, and in order to give the discipline a religious finishing, the crowd make

for the church, and turn three times round the sacred edifice. This turning round the church has ceased in some places, but was a common practice some forty years ago in administering this mode of punishment. But should the offender escape, or in some way elude his pursuers, the spokesman then would mount the wooden horse. Occasionally, also, the guilty parties were placed together on the back of the horse. This custom is in full swing up to now, at least in some neighbourhoods. We recently read an account of a similar event in Cardigan, and the matter in the end went to the law court. The case was reported in "Cronicl y Cymry." There still prevails in Pembrokeshire, and in certain localities in the adjoining counties, a custom which, doubtless, is related to Mari Lwyd, for all that one can make out. We refer to the custom locally known as "mynwenta" or "penwenta." It is difficult to make out the meaning of the word in this relation, but the custom has so many features like Mari Lwyd that it is thought the two were originally identical. In country places farmers are so scattered that young folk are unable to meet each other except occasionally. But about the spring or beginning of May, when the farmer brings a cart-load or two of corn to be ground in the mill, it is customary to attend to the task the night through. Young people of both sexes are told, somewhat privately, that the "mynwent" or "penwent" of so-and-so is to be at the mill on such and such a night. Then a horse's head is prepared in a manner similar to that in use in acting Mari Lwyd, so that it can be made to open and bite. Dialogues and every kind of merriment follow, very much the same as in Mari Lwyd, as will be more fully explained again. The practice may have fallen into disuse now. My informant had himself been engaged in this kind of play some thirty years ago.

Another custom is also met with in those parts of Wales, called "Bwca Llwyd," which must have been derived from Mari Lwyd, not only on account of the name, but also because of the similarity of features in both institutions. This custom is as follows:—A horse's head made of canvas is prepared. This is painted and stuffed with hay. A hay fork, the blades covered over with leather, does duty for ears, the handle being manipulated by the person inside, who guides the movements of the head as he wishes. I am told that this is taken round on All Hallow's Eve. It will thus be seen that the time at which Bwca Llwyd is played does not coincide with either the Saturnalia or the Floralia, but follows the sports and pastimes observed at the season of All Saints. The bonfire or coelcerth night in the North, Scotland, and other places, nut cracking, eating apples, candle lighting, with several other amusements, seem to have sprung partly from Druidic and partly from mediæval rituals. It cannot now be ascertained why "Bwca Llwyd" is played at this time of the year in particular.

We now come to the Mari Lwyd institution, as performed in Gwent and Morganwg, as well as in some parts of Brecknockshire, &c.

The chief theatre of the custom is Monmouth and Glamorgan, and this name is used only in those parts. Proceed we to describe the

play as acted in its greatest splendour by the Gwent folks themselves. As may be seen the Feasts of Balaam's Ass, and the flight of Joseph and Mary with the child to Egypt, with the dialogues spoken by the several characters in the different religious dramas performed during the festive seasons, form features of the Mari Lwyd play. Before Christmas comes round the young folk look out for the head of a horse, or a mare, or that of a he ass or she ass. It is worthy of notice that the head employed some time ago, was invariably that of an ass, but now it is of no importance whether it be that of an ass or a horse, both being indiscriminately used. Having found a head, a wooden arrangement is provided in lieu of a jaw, which has a spring attached so as to enable it to open and shut, at the command of the manipulator, to bite people, to eat grass, to neigh and do other things besides speaking. The head is decorated with ribands of various colours, and feathers are placed on the few parts remaining undecorated. The head is provided with a mane, and a pole is driven through instead of a backbone. A canvas cover is placed over the and also over the man who steers the apparatus, which is now called a "Mari Lwyd," and is the principal actor in the play. The frame-work is made to resemble a real head as closely as possible, and now the remaining characters are appointed. These sometimes are four singers, with, perhaps, two to represent Punch and Judy. Two of the characters are called sergeant and corporal. But these are not invariably the same. Sometimes one of these plays a fiddle and does the work of merryman. Thus the number, the work, or the costume of the actors is not uniformly the same. The costumes of all concerned, if possible, are clean and tidy, and gaily dressed with ribbons, and sometimes broad and pretty sashes are worn round the waist. The company start on Christmas eve, and are engaged in the play for a fortnight, three weeks, or even a month.

The play is conducted in the following fashion :—Having arrived, say, at some respectable house, the six men—Mari Lwyd, the leader, the sergeant, the merryman, and Punch and Judy—now start singing short verses craving for admittance. The husband, or someone else inside acquainted with the play responds, and refuses entrance. Should the person inside show greater aptitude than the Mari Lwyd without, or the person versifying, then it is legitimate to keep the party out of the house altogether. But usually, after a lengthy dialogue, they are permitted to go in. Instances are known of such dialogues being conducted for an hour or more. The following is a specimen of the dialogue in use :—

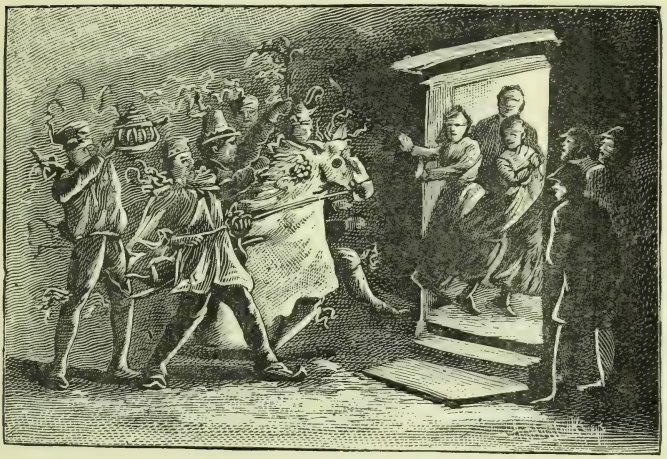
MARI LWYD (Loq.)

1 Wel, dyma ni'n dwad, Gyfeillion diniwad, I mofyn am genad I ganu.	1 Well, here we come,* Innocent friends, Asking permission To sing.

* For the literal translation of these verses we are indebted to Mr. T. C. Evans (*Cadwawd*), in whose "History of Llangynwyd," a variant can be seen at p. 161.

THE ENTRY OF THE MARI LWYD
(GLAMORGANSHIRE, 1895).

SKETCHED BY T. H. THOMAS.



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2 Whech o wŷr hawddgar,
Rhai gora ar y ddeiar,
I ganu mewn gwirar
Am gwrw.

2 Six amicable fellows,
The best upon earth,
And truly to sing
For beer.

3 Ma ffashwn cwnsela,
Er's mil o flynydda,
A hyny miwn ffurfia,
Gwna biofi.

3 The fashion of wassailing
Is since a thousand years
An old form (or custom)
I can prove.

4 Cenwch eich gora,
Felly gnaf fina,
A'r sawl a fo ora
Geiff gwrw.

4 You sing your best,
And so will I,
And whichever sings best
Shall have the beer.

5 Mae'm dawn i'n cynhyrfu
Wrth feddwl am ganu,
Y nos yn y gwely
Mi goeliaf.

5 I am moved by the gift in me
When thinking out my song,
Even at night in my bed,
This is true.

6 Mi ganaf am wythnos,
A hefyd bythewnos,
A mis os bydd achos,
Baidd ichwi.

6 I can sing for a week,
Yea, for a fortnight,
Or a month, if required—
A challenge to you.

7 O, tapwch y faril,
Gollyngwch yn rhigil,
Na fyddwch ry gynnil
I ganwyr.

7 O, tap ye the barrel,
Let it run freely,
Do not be saving
To singers.

8 Mae Mari Lwyd lawen,
Am ddod i'ch tŷ'n rhonten,
A chanu yw 'i diben,
Mi dybiaf.

8 Mari Lwyd the cheerful,
A frisker, would enter,
And to sing is her object
I trow.

THE RESPONSE (inside).

9 Rhowch glywed, wŷr doethion,
Pa faint y'ch o ddynion,
A pheth, yn wych union,
Yw'ch enwa?

9 Let us hear, wise men,
The number you are,
And what your names may be
Properly.

10 Rhowch glywed, wŷr difrad,
O b'le 'r y'ch chi'n dwad,
A pheth y'ch gofyniad,
Gaf enwi?

10 Let us hear, not treacherous men,
From whence you come,
And what is it you ask,
We demand.

11 Mi gwnas o'r gwely,
Gan lwyr benderfynu,
Y gwnawn i dy faeddu
Di'n foddus.

11 *I rose from my bed
Fully determined
Of beating you
Agreeably.

* In these verses singular and plural are mixed up; this is accounted for by the way the answers were given: when the wassailers sung together the introductory verses they sung "we," but when it came to "*pwnco*"—making rhymes at the time in answer to each other—it was left to one, and he, of course, would say, "I rose from my bed," &c.

12 'Dyw gwiw i chwi scwto,
A chwnu'r latch heno,
Waith prydydd diguro
Wyf, gwiriaf.

12 You need not push
And raise the latch to-night,
Because I am an unbeaten poet,
And that I will prove.

13 I ffwrdd a chi'r lladron,
Ewch ymaeth yn union,
Ni chewch chi yn hylon
Fy ngwelad.

13 Away with you, robbers,
Depart at once,
You shall not merrily
See me.

FROM WITHOUT.

14 Mi ganaf am flwyddyn,
Os caf fi Dduw'm canlyn,
Heb ofni un gelyn
Y gwylia.

14 I will sing for a twelvemonth,
If God will follow me,
Without fear of any foe
This holiday.

FROM WITHIN.

15 Mae Jenkins, y ffeirad,
Yn dyfod, ar f'enad,
Gna fe i chi fynad
O f'annedd

15 Jenkins, the parson,
Is coming, upon my soul,
He will make you go
From my dwelling.

Then Mari Lwyd advances, the leader taking hold of the rein, and before the house is entered, some verses like the following are sung:—

FROM WITHOUT.

16 Y tylwyth teg o'r teulu,
A ddewch chi i'r gola heb gelu,
I weld y wassel yn ddiath,
Nid oes ei bath yn Nghymru.

16 The good people of the family
Will you bring a light from your hiding,
To see the wassail without shock
(or painful sensation),
There is not like unto her in all Wales.

17 Mae'n berllan o lydan floda,
O lwyrfryd heirdd a lifra,
Rhibana gwychion, brithion braf,
A luniwyd yn ddolena.

17 She is an orchard of flowers,
Displaying beautiful livery,
Gay ribbons of many colours,
Artfully tied up in knots.

18 Mae'n gaseg lwyswedd wisgi,
Mae miloedd yn 'i moli,
Ei phen yn gnotog enwog iawn,
O foddion llawn difaeddu.

18 She is a mare of holy and brisk
appearance,
There are thousands praising her,
Her head eminently knotted
With material which cannot be
surpassed.

19 Daw'r sergeant gwych a'i gwmni,
Yn wrol i'n blaenori,
At y gwaith mae eto i'w ga'l
Wych, wastad gorpral gwisgi.

19 The brave sergeant and his company
Will boldly lead us,
And for the work we also have
A gallant and an alert corporal.

20 Daw'r oslar gyda'r gaseg,
A ledia hon yn landeg,
A'i ffrwyn a'i gyfrwy gydag e,
I rodio'r lle dan redeg.

20 The ostler attending the mare
Will lead her comely and fair,
Bringing with him his bridle and
saddle,
To step the place and run about (or
trot around).

21 Daw hefyd Bwnch a Shuan,
Ar unwaith o'r un anian,
Dau filan draw, 'run lliw a'r drwg,
Neu'r annedd fwg ei hunan.

21 There will be also a Punch and Judy,
Both of the same instinct,
Two villains of the colour of the evil one,
Or of the chimney place itself.

22 Yn awr 'rwy'n darfod canu,
Rhowch imi i ymborthi,
Blwyddyn newydd dda i chi gyd,
A phawb o'r byd serch hyny.

22 Now, my song is ended,
Allow us to be feasted,
A good New Year to you all,
And all the world "for all that."

Afterwards Mari Lwyd goes in, first to the women—with puffing, snorting, neighing, pretended shying, and showing various equine antics, besides conversing. The merryman with his fiddle follows, performing every funny trick he can. They then sing the verse—

Wel, dyma'r hoenus feinwen,
Sy'n codi gyda'r seren ;
A hon yw'r *wassail* wych ei chlod,
Sy'n caru bod yn llawen.

Here is the blithesome maiden
Who rises with the star,
She is the wassail of far fame
And loveth to be merry.

Then Judy comes, carrying a broom to sweep the hearth. After her walks Punch, and throws Judy down. A scuffle ensues. Punch afterwards kisses the women, and Judy pursues him with her broom. Then, having sung, danced, and played sufficiently long, all sit at the table, and are treated to meat and drink. Having acted the whole drama they sing :—

Duw rhoddo i'ch lawenydd
I gynnal blwyddyn newydd ;
Tra b'o crwth a thincian cloch,
Gwell, well, y b'och chwi beunydd.

May God give you happiness
With the new year ;
As long as *crwth* or bells shall sound
May you fare better daily.

Ffarweliwch, foneddigion,
Ni gawsom roesaw ddigon ;
Bendith Duw f'o ar eich tai,
A phob rhyw rhai o'ch dynion.

Farewell unto you, gentlemen,
Our welcome has been plenteous ;
Blessing of God be on your home,
And each one of your people.

The description of the action of this improvised drama, and the opening verses given above, in which many expressions witness to an ancient origin, have led the writer to connect the custom with the festivals fully illustrated in the early portion of the essay, and thus Mari Lwyd (Blessed Mary) reminds us of the flight to Egypt and the equine or asinine discourse of the Feast of Balaam's Ass, while the dialogues and characters recall Coventry with its mysteries and other dramatic representations.

NOTE : *Bibliography, &c.*—In addition to the information given by this article, further notices may be found in a paper by the late Mr. David Jones, of Wallingford, in "Archæologia Cambrensis" for 1888, p. 389 ; in "British Goblins," by the Hon. Wirt Sikes, and in "The History of Llangynwyd Parish," by Mr. T. C. Evans (Cadrawd), 1887, p. 161 (all in the Cardiff Free Library). At the Cardiff Museum, in the "Old Fashion Collection," may be seen a specimen of the ornamental horse's head used in the custom of "Mari Lwyd," which was obtained by Mr. T. C. Evans for illustration of the paper by Mr. D. Jones above cited.

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